

# User Manual for the Risk Mitigation Strategy Tool in QGIS

**Tutorial**



**ETH** zürich

**SPUR**  
Spatial Development and Urban Policy



Conceived by

 **UNHCR**  
The UN Refugee Agency  
Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaciun Svisra

Swiss Agency for Development  
and Cooperation SDC



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**humanitarian**  
planning hub

**SPUR**

Spatial Development and Urban Policy



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## About this Document

The manual for the Risk Mitigation Strategy Tool consists of two documents:

- General Manual
- Tutorial (this document)

The **General Manual** explores the integration of the Risk Mitigation Strategy Tool into the broader context of the project. It also covers installation instructions, QGIS project setup, and provides additional insights to enhance your understanding of the analysis. It also suggests a way to use the tool when you don't have any data to start with. It also offers suggestions for suitable data to use when local knowledge-based data based is unavailable.

In **this document**, you will find a detailed step-by-step analysis showing the use of the GIS plugin. The example used throughout the tutorial is based on the Al-Redis settlement in Sudan. In cases where data is unavailable for this example, an alternative example will be presented to demonstrate the functionality. Regardless of the location you choose, you can follow this guide seamlessly by simply selecting the appropriate data for your chosen area.

Each step is explained in detail, with various data options and configurations highlighted. Steps marked as “optional” are not essential for the tool’s functionality but are intended for adjustments on data that can enhance the accuracy of results.



Please follow the instructions thoroughly, as errors may occur if steps are skipped or not followed as outlined.

# Step-by-step Guide

Please follow all steps making use of the numbered blue buttons to finally create the risk map and the risk mitigation strategy.



## Step 1 – Selection of basemap and definition of settlement extent

Adjust the map view so that the focus is on the settlement of Al-Redis in Sudan. The easiest way to do this is to copy the following values into the status bar located at the bottom of QGIS.

Coordinate 12.588338, 32.77774

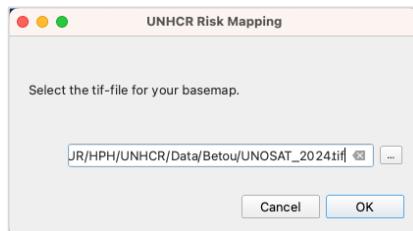
Scale 1:4709



Click on button **1** of the plugin to change the basemap and outline the extent of your settlement or the area you intend to analyze.

### Basemap

The default basemap for any project is “Google Satellite Hybrid”. You can change the basemap of the project before you define the extent of the settlement. If you choose to do so, you can upload the appropriate tif-file.



You are also able to use a Tile as a basemap by adding the Tile to the project and renaming it to “Basemap”.

### Settlement extent

Once you have confirmed the request to draw the settlement area, you can define the boundaries of the settlement by left-clicking to set edge points. Complete the drawing by right-clicking.



Make sure the *SettlementArea* Layer is selected by clicking on the layer name (not the check box) in the Layers Window.





## Step 2 - Upload data

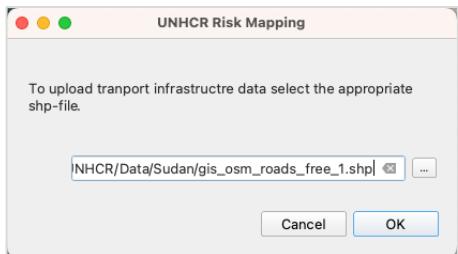
To choose the data for analysis, click the button 2 and upload the required files sequentially. You must upload at least one flood dataset (riverine or pluvial) and one asset dataset (buildings or roads). For demonstration purposes, this manual will cover all available upload options. Where no data exists for the Al-Redis settlement example, a different example will be used. For building and riverine data, there is the option to upload data in different formats, which will also be demonstrated.



### Transport infrastructure

To upload transport infrastructure data, select the appropriate shp-file.

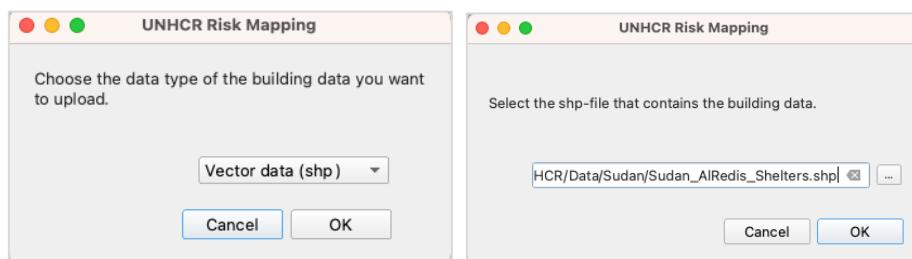
Input: shp-file



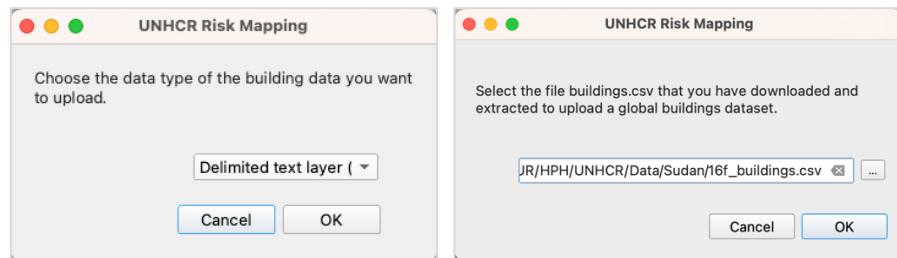
### Buildings

Building data can be uploaded either as a csv-file, which will be converted into a shp-file, or directly as a shp-file. To upload building data, select the desired or available data type and choose the corresponding file.

Data: shp-file



Data: csv-file

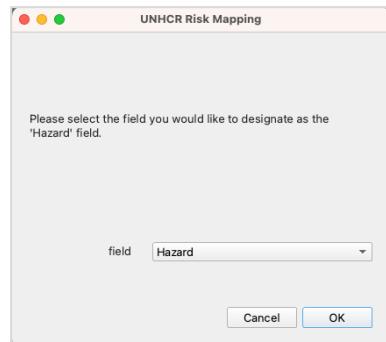
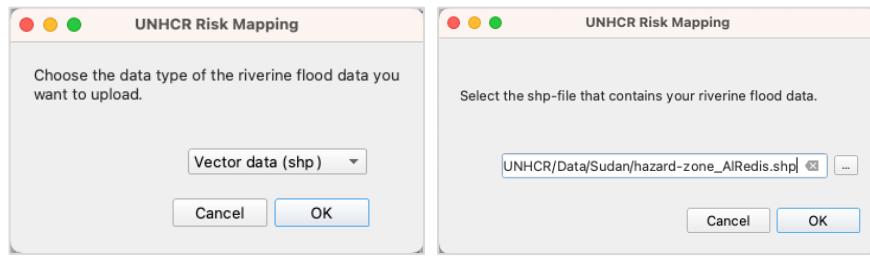


### Riverine flood

Riverine flood data can be uploaded either as multiple tif-files, one for each repeat year, or as a shp-file. To upload riverine flood data, select the desired or available data type and choose the corresponding file(s).

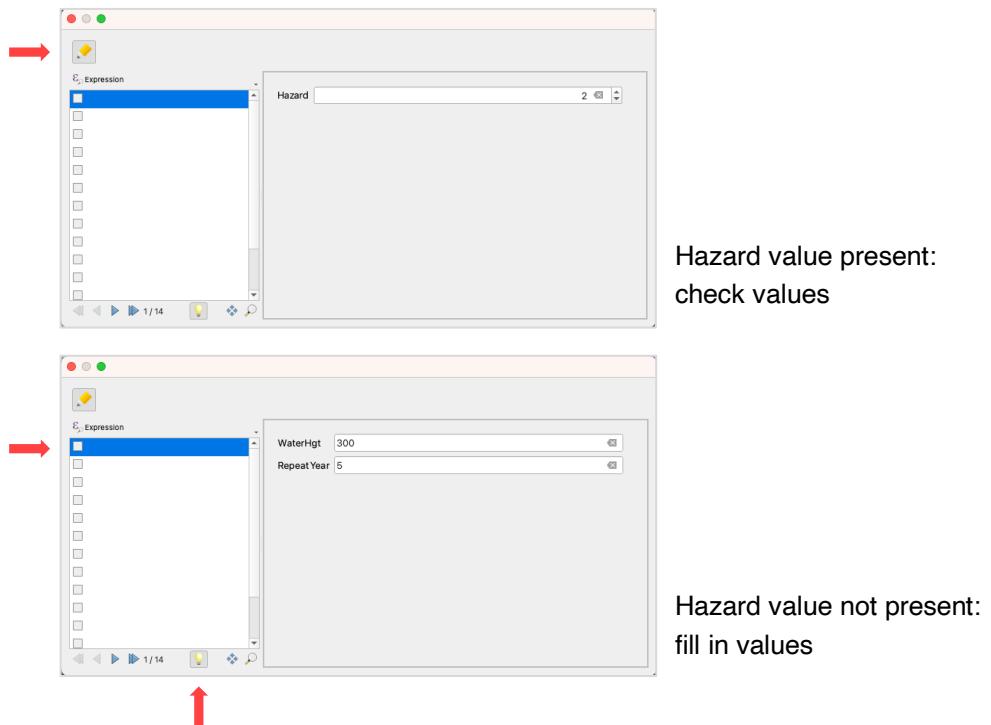
When selecting the [shp-file](#) option, you can designate an existing field in the dataset to correspond to the 'Hazard' value. The selected field will be used as the 'Hazard' field and displayed in the attribute table, eliminating the need to manually input values. If no suitable field is available, you will need to fill in the values for Water Height and Repeat Year, which will then be used to calculate the 'Hazard' value.

Data: shp-file



Hazard value present: select field

One of the following windows will appear where you need to edit the attribute table of the riverine flood data to make sure that all the required information is present. To start editing, click on the edit button in the upper left corner. To know where the feature is located, activate the light bulb and click on the feature in the table, which will make it light up red on the map.

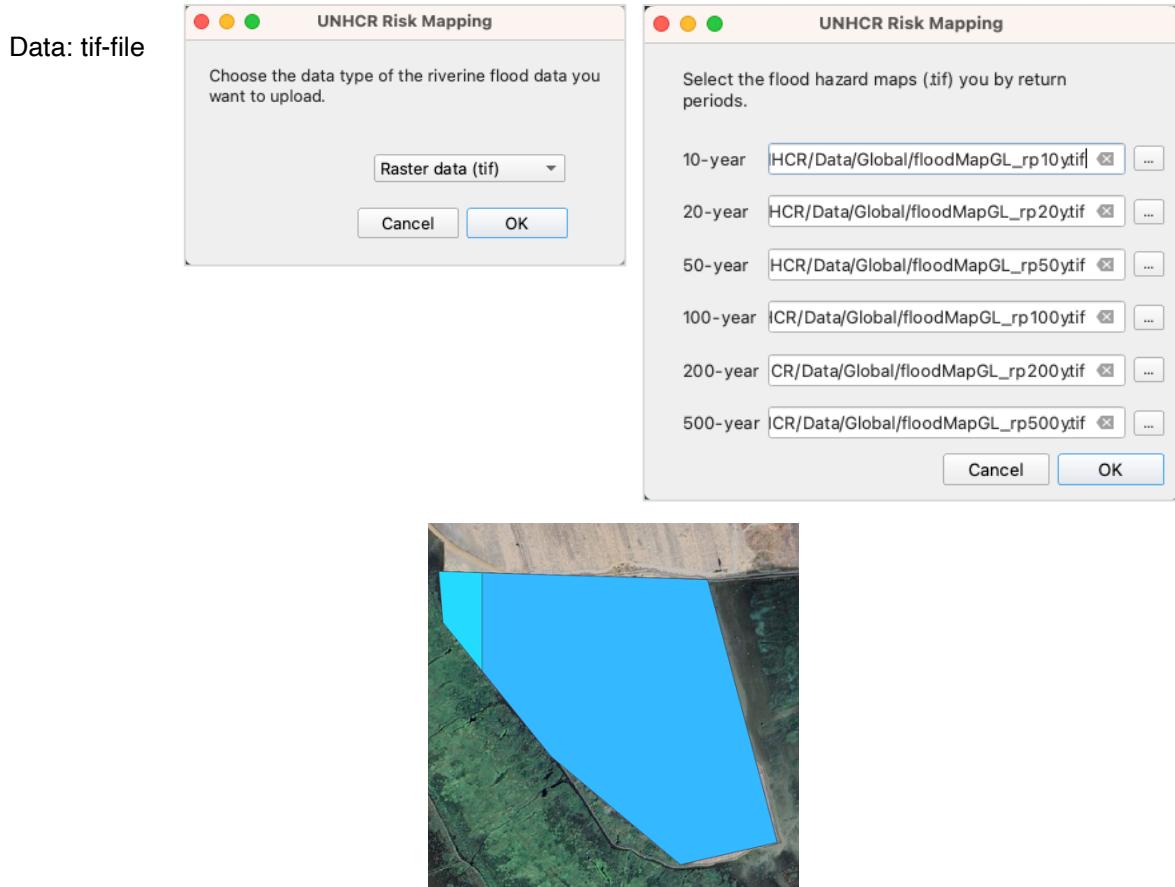


Save your changes by clicking on the edit button again. Finally, close the window.



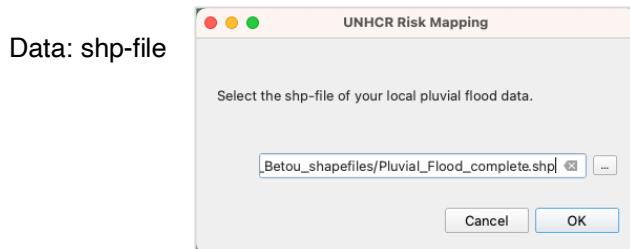
- ⓘ Find out more about Water Height, Repeat Year and Hazard of a flood event in the **General Manual** under “Riverine flood attributes” to understand the appropriate values to enter.

When selecting the **tif-file** option, you must upload a separate file for each return period, where each file contains information about water heights. The plugin will process these files and merge them into a single layer.

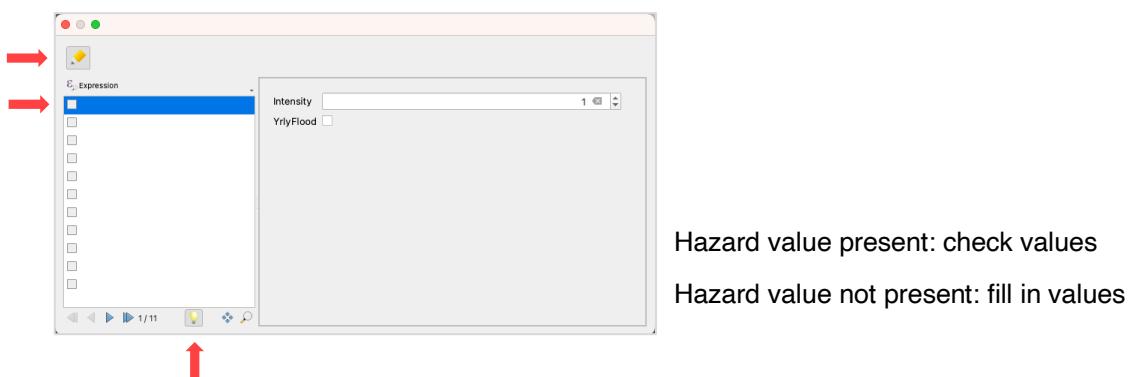


### Pluvial flood

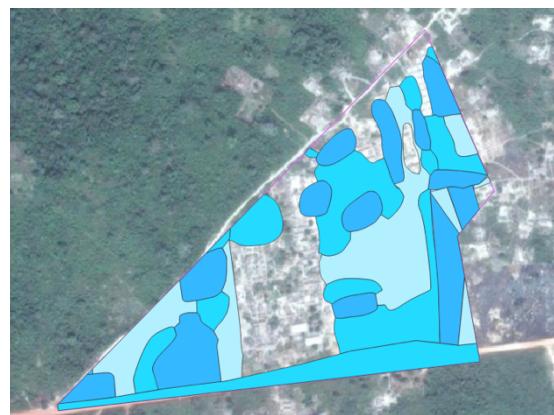
Pluvial flood data can be uploaded as a shp-file. To upload, select the corresponding file. You are then able to designate an existing field in the dataset to serve as the ‘Intensity’ value. The selected field will be displayed in the attribute table, removing the need to manually input values. If no suitable field is available, you must fill in the values manually. In either case, you must also specify whether the event occurs annually or not, which will influence the calculated hazard value.



After uploading the pluvial flood data, the following window will appear. Depending on whether an existing ‘Intensity’ field is present, the table will either display pre-filled values or remain empty. You need to edit the attribute table of the pluvial flood data to make sure that all the required information is present. To start editing, click on the edit button in the upper left corner. To know where the feature is located, activate the light bulb and click on the feature, which will make it light up red on the map.



Save your changes by clicking on the edit button again. Finally, close the window.



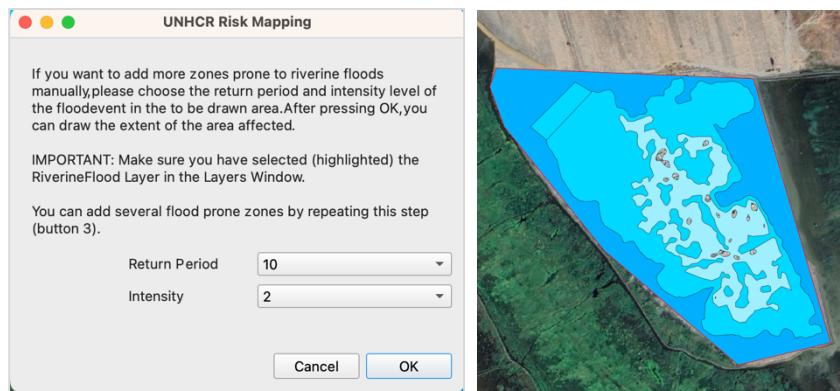
- ⓘ Find out more about Intensity and Yearly Flood of a flood event in the **General Manual** under “Pluvial flood attributes” to understand the appropriate values to enter.

- ⚠ For the case of Al-Redis, pluvial flood data is not available. A different example is used to demonstrate the functionality.

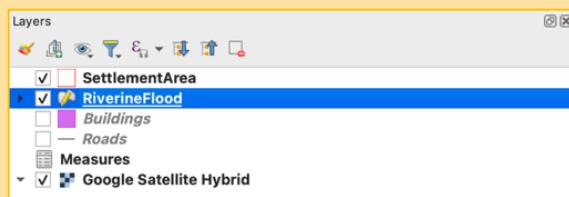
## Step 3 - Riverine flood adjustment [optional]

If you want to add more or adjust zones prone to riverine floods manually, click on button **3**.

Select both the return period and intensity level for the flood event within the designated area. Click OK and proceed to outline the extent of this flood event on the map using left-click for edge points and right-click to conclude the drawing.



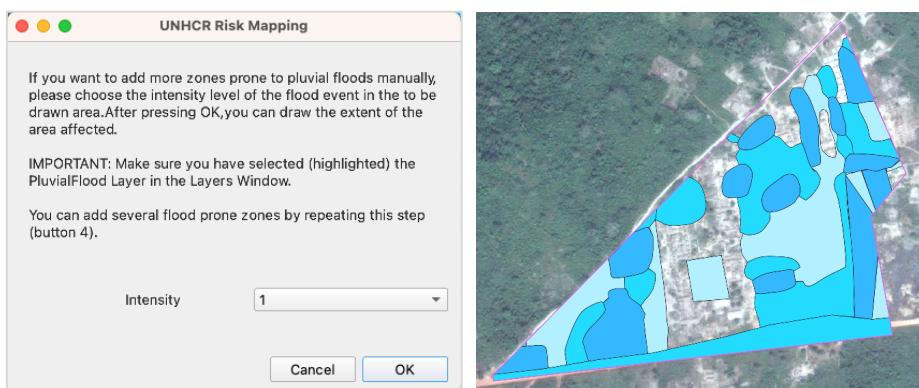
**⚠** Make sure the *RiverineFlood* layer is selected by clicking on the layer name (not the check box) in the Layers Window.



**ⓘ** You can add or adjust several flood prone areas by repeating this step.

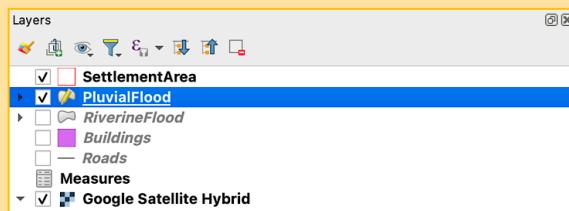
## Step 4 - Pluvial flood adjustment [optional]

If you want to add or adjust zones prone to pluvial floods, you can do it manually by clicking on button **4**. Again, choose the intensity level for the flood event within the designated area. Click OK and proceed to outline the extent of this flood event on the map using left-click for edge points and right-click to conclude the drawing.





- Make sure the *PluvialFlood* layer is selected by clicking on the layer name (not the check box) in the Layers Window.



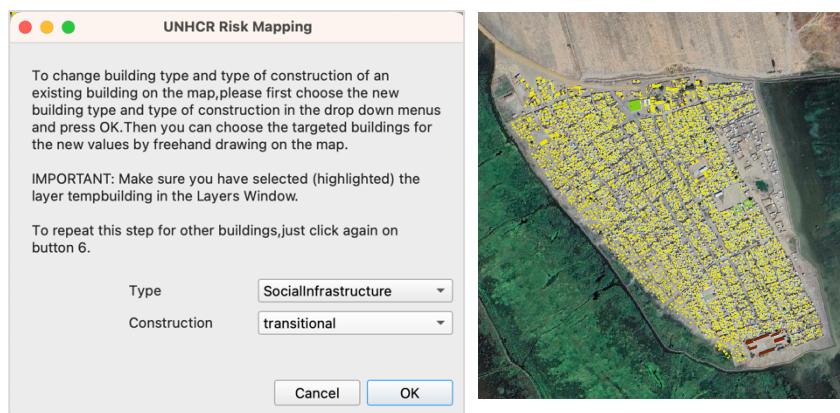
- You can add or adjust several flood prone areas by repeating this step.

## Step 5 - Risk area calculation

In the fifth step, the hazard areas and corresponding risk intensities are automatically calculated. You have the possibility to adjust the findings in later steps. Click on button **5** and press OK. Wait until the layers are added and the success message appears.

## Step 6 - Adjust buildings [optional]

By default, all loaded buildings are categorized as “Residential Shelters” with “transitional” construction. In step **6**, you can modify the building type and type of construction of an existing building. Select the desired building type and construction type from the drop-down menus and confirm by clicking OK. Subsequently, designate the specific buildings for the updated values by drawing on the map, using left-click for edge points and right-click to conclude the process.



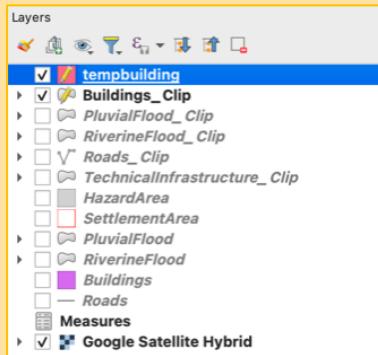
- You can adjust several buildings by repeating this step.

If you need to remove one or multiple preloaded buildings, please refer to the “QGIS Workarounds” section in the **General Manual** for detailed instructions.



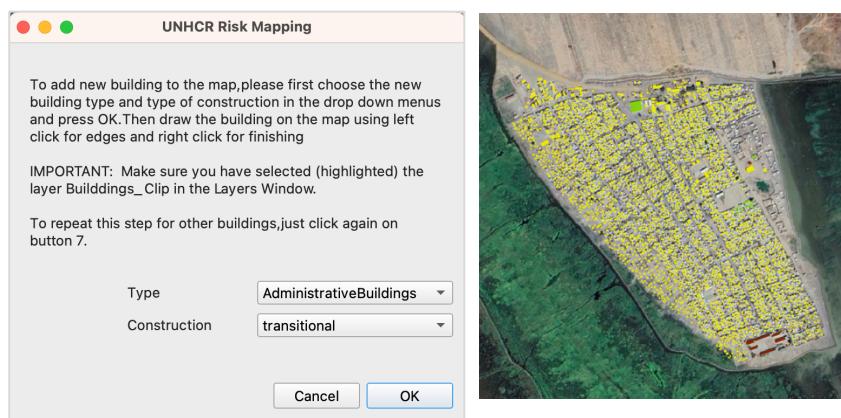
- Find out more about Type and Construction of a building in the Overall Guide under “Types of vulnerable assets” and “Type of construction”.

- ⚠** Make sure the *tempbuilding* layer is selected by clicking on the layer name (not the check box) in the Layers Window.



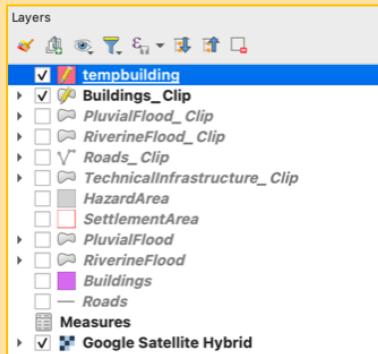
## Step 7 - Add buildings [optional]

To add new buildings to the map, click button 7. Select the building type and construction type from the dropdown menus and confirm by clicking OK. Subsequently, outline the structure by using left-click for edge points and right-click to complete the drawing.



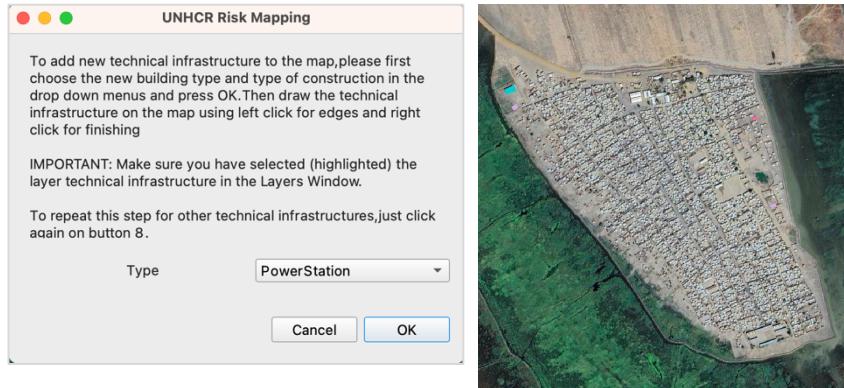
- ⓘ** You can repeat this step for all missing buildings.

- ⚠** Make sure the *tempbuilding* layer is selected by clicking on the layer name (not the check box) in the Layers Window.

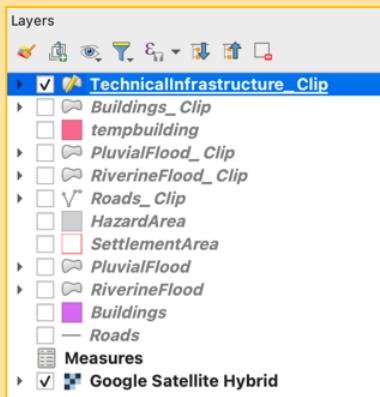


## Step 8 - Add technical infrastructure [optional]

To add technical infrastructure to the map, click button **8**. Select the type from the dropdown menu and confirm by clicking OK. Subsequently, outline the structure by using left-click for edge points and right-click to complete the drawing.



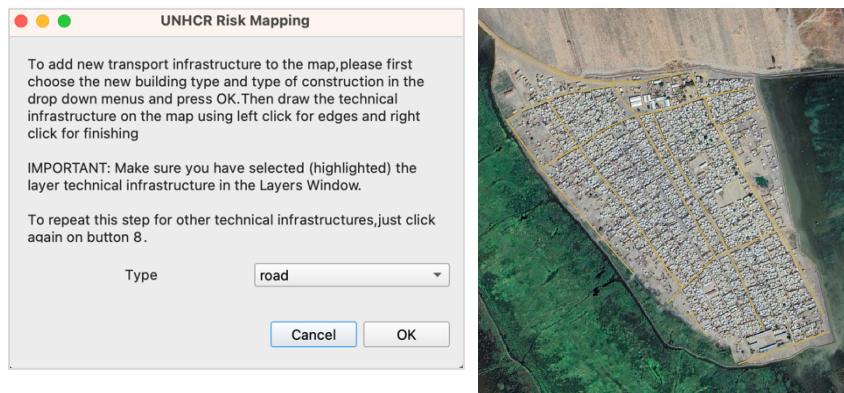
Make sure the *TechnicalInfrastructure* layer is selected by clicking on the layer name (not the check box) in the Layers Window.



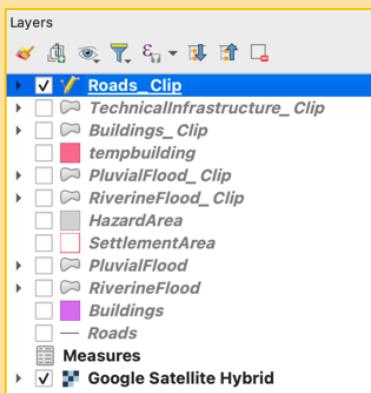
You can repeat this step for all missing technical infrastructure.

## Step 9 - Add transport infrastructure [optional]

To add transport infrastructure to the map, click button 9. Select the type from the drop-down menu and confirm by clicking OK. Subsequently, outline the structure by using left-click for edge points and right-click to complete the drawing.



Make sure the *Roads\_Clip* layer is selected (and highlighted – see image below) by clicking on the layer name (not the check box) in the Layers Window.



You can repeat this step for all missing technical infrastructure.

If you need to remove one or multiple preloaded roads or bridges, please refer to the workaround section for detailed instructions.

## Step 10 - Calculate risks

In this step, the risk of every building, transport infrastructure and technical infrastructure is automatically calculated, based on the flood hazard as well as physical and socioeconomic vulnerability. Click button **10** and start the calculation by pressing *OK*. Wait until the layers are added and the success message appears.



## Step 11 - Adjust risk [optional]

To adjust the risk level manually, click on button **11**. Choose the layer (type of asset and flood) to be adjusted from the drop-down menu and select the new risk level value. Confirm by clicking *OK* and outline the area by using left-click for edge points and right-click to complete the drawing.

To adjust the risk level manually, first choose the layer (type of asset and flood) from the drop down menu. Then select the new risk level value (1-5). After pressing OK, you can select the area to be adjusted using left click for edges and right click for finishing.

IMPORTANT: Make sure the temp layer is selected (highlighted) in the Layers Window.

To change the risk level of several zones, repeat this step (button 11).

Layer: Buildings Riverine

Risk: 4

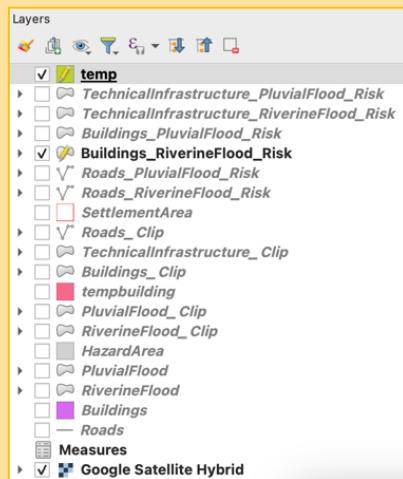
Cancel OK



You can repeat this step to change the risk level of several areas.

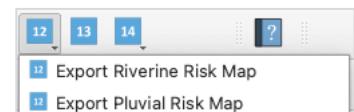


Make sure the *temp* layer is selected by clicking on the layer name (not the check box) in the Layers Window.

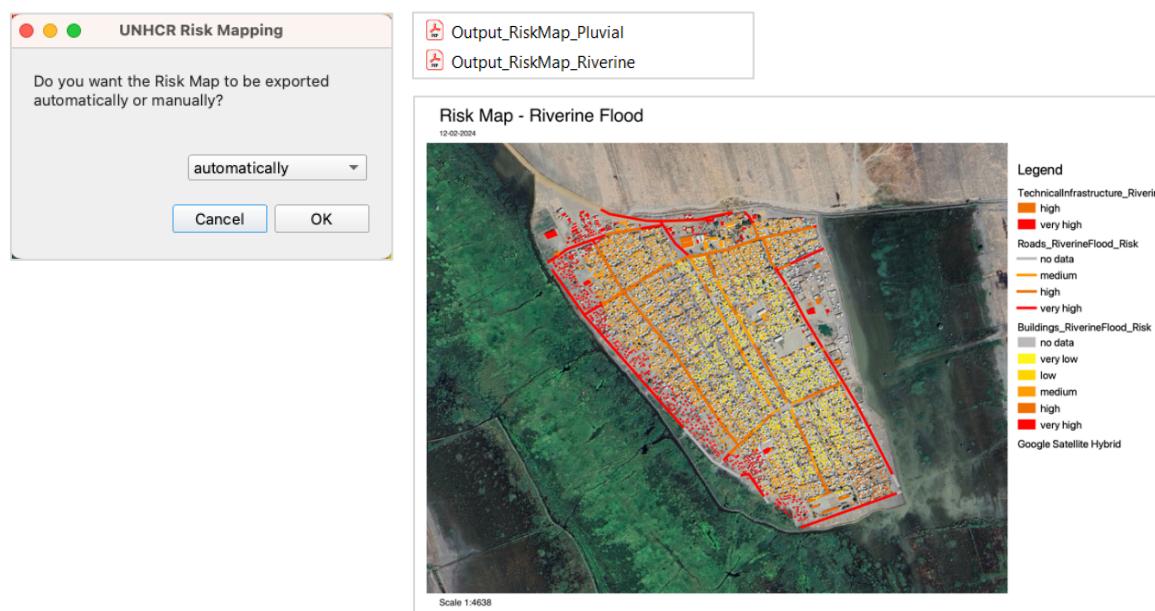


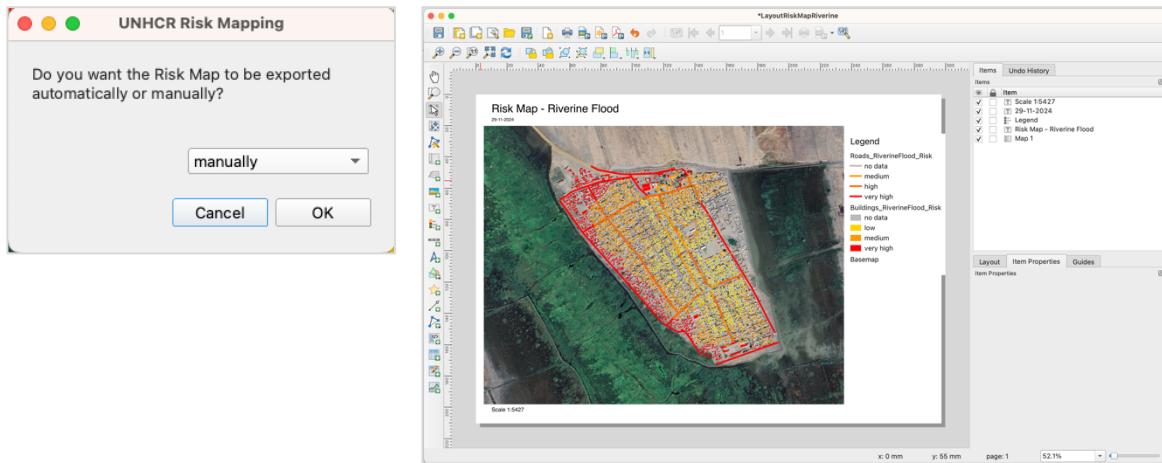
## Step 12 - Export risk map

To export the risk maps, press Button 12 . Click on the one you wish to export. After confirming your selection, you can choose between Automatic Export or Manual Export:



- Automatic Export: The map will be exported as a PDF using a predefined template and saved to your project folder automatically.
- Manual Export: The layout editor will open, allowing you to customize the template to your preferences. Once satisfied with your changes, you must export the map manually from the layout manager.





- i** If you are modifying data, you can regenerate the risk maps by clicking button 12 once again. If you wish to retain the existing maps, it is necessary to either copy them to another folder or rename them, as the current maps will be overwritten.

## Step 13 - Choose risk mitigation measures

You can filter the selection of potential risk mitigation measures to incorporate into the risk mitigation strategy by clicking on button 13. Choose the preferred characteristics for the measures across various categories and then press OK.

Type of Intervention	Scale of Intervention	Targeted Natural Hazard
<input checked="" type="checkbox"/> Engineered	<input checked="" type="checkbox"/> Shelter-Plot-Block	<input checked="" type="checkbox"/> Pluvial Flood
<input checked="" type="checkbox"/> Nature-Based	<input checked="" type="checkbox"/> Settlement	<input checked="" type="checkbox"/> Coastal/Riverine Flood
<input checked="" type="checkbox"/> Hybrid	<input type="checkbox"/> Supra-settlement	
<input checked="" type="checkbox"/> Non-Structural		

Targeted Vulnerable Asset	Strategy Type	Implementation Time
<input checked="" type="checkbox"/> Buildings	<input checked="" type="checkbox"/> Relocate	<input checked="" type="checkbox"/> Short (1 day - 1 month)
<input checked="" type="checkbox"/> Transport	<input checked="" type="checkbox"/> Reduce Hazard Magnitude	<input checked="" type="checkbox"/> Medium (1 month - 1 year)
<input checked="" type="checkbox"/> Technical Infrastructure	<input checked="" type="checkbox"/> Reduce Asset Vulnerability	<input type="checkbox"/> Long (> 1 year)
<input type="checkbox"/> Land Cover	<input checked="" type="checkbox"/> Reduce Casualties	

Effect Duration	Investment Costs	Maintenance Costs (yearly)
<input checked="" type="checkbox"/> Short-term (< 1 year)	<input checked="" type="checkbox"/> Low	<input checked="" type="checkbox"/> Low (< 10% investment costs)
<input checked="" type="checkbox"/> Medium-term (1 year to 10 years)	<input checked="" type="checkbox"/> Medium	<input checked="" type="checkbox"/> Medium (10-50%)
<input type="checkbox"/> Long-term (> 10 years)	<input type="checkbox"/> High	<input type="checkbox"/> High (> 50%)

- i** Find out more about the categories in the Compendium.

- ⚠** Ensure that you have selected at least one item per category. It is possible that specific combinations of chosen categories may not yield any measure output, therefore we recommend including more options rather than fewer.

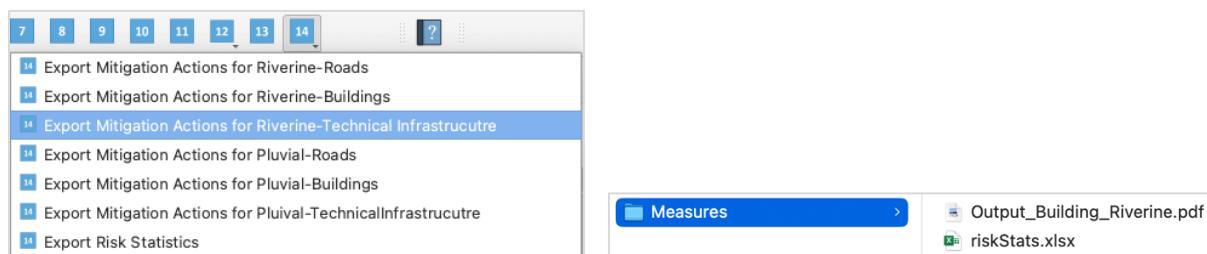
## Step 14 - Export risk maps including risk mitigation measures

To export risk maps including the risk mitigation strategy, and risk statistics, press Button 14 . Each document must be selected for export individually.

You can choose between automatic export or manual export for the risk maps:

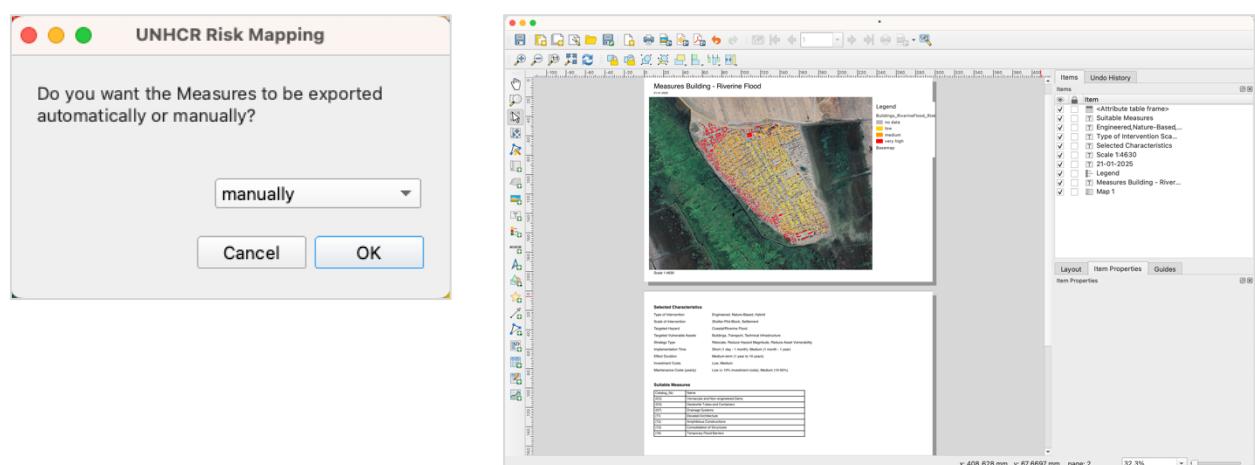
- Automatic export: Files will be exported as PDFs using predefined template and saved to your project folder under 'Measures'.
- Manual Export: The Layout Editor will open, allowing you to customize the templates before manually exporting the files.

The risk statistics will always be exported automatically and saved also saved under 'Measures'.



**i** If you need to regenerate the risk mitigation strategy after adjusting the data in the preceding steps, simply click on button 14 again.

To preserve the existing files, it's essential to copy them to another folder, as they will be overwritten.



**UNHCR Risk Mapping**

Do you want the Measures to be exported automatically or manually?

automatically ▾

**Cancel** **OK**

**Measures Building - Riverine Flood**  
21-01-2025

Scale 1:4630

**Selected Characteristics**

Type of Intervention	Engineered, Nature-Based, Hybrid
Scale of Intervention	Shelter-Plot-Block, Settlement
Targeted Hazard	Coastal/Riverine Flood
Targeted Vulnerable Assets	Buildings, Transport, Technical Infrastructure
Strategy Type	Relocate, Reduce Hazard Magnitude, Reduce Asset Vulnerability
Implementation Time	Short (1 day - 1 month), Medium (1 month - 1 year)
Effect Duration	Medium-term (1 year to 10 years)
Investment Costs	Low, Medium
Maintenance Costs (yearly)	Low (< 10% investment costs), Medium (10-50%)

**Suitable Measures**

Catalog_No	Name
(02)	Vernacular and Non-engineered Dams
(03)	Geotextile Tubes and Containers
(07)	Drainage Systems
(11)	Elevated Architecture
(12)	Amphibious Constructions
(13)	Consolidation of Structures
(14)	Temporary Flood Barriers