

User Manual for the Risk Mitigation Strategy Tool in QGIS

Tutorial Global Data





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planning hub

SPUR
Spatial Development and Urban Policy



About this Manual

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

- General Manual
- Tutorial Local Data
- Tutorial Global Data (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.


In **this document**, you will find a detailed step-by-step **tutorial** showing the use of the GIS plugin. The example is based on the Al-Redis settlement in Sudan, using only global data sources. **Even if you choose a different location, you can move seamlessly through this guide by simply selecting the appropriate data for your chosen area.**

The **tutorial on local data** offers the same detailed steps but with a focus on utilizing local data sources.

This tutorial begins with instructions for downloading global data and continues with detailed explanations for each step. 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.

Download Global Data

In preparation, it is essential to download all the necessary data required to perform the analysis.

 You can find information on data sources and content in the **General Manual**

Transport infrastructure

Go to <https://download.geofabrik.de>. Select the Sub Region *Africa* and download the shp-file of Sudan.

Sub Region	Quick Links		
	.osm.pbf	.shp.zip	.osm.bz2
Africa	[.osm.pbf] (5.4 GB)	✘	[.osm.bz2]
Antarctica	[.osm.pbf] (31.0 MB)	[.shp.zip]	[.osm.bz2]
Asia	[.osm.pbf] (11.1 GB)	✘	[.osm.bz2]
Sudan	[.osm.pbf] (91 MB)	[.shp.zip]	[.osm.bz2]

Open your download folder and unzip the folder you have just downloaded. Save it to a folder you will remember.

Dataset building

Go to <https://sites.research.google/open-buildings/#download>. Select the area of Sudan that contains the city of Khartoum. You can also enter the name of the city in the search bar. Click on the map to download the file. It is called "169_buildings.csv.gz". Save it in a folder you will remember.



If you are a Windows user utilizing a version older than 11, it is necessary to employ the 7-Zip software to unzip the ".gz" file. You can download it from <https://www.7-zip.org/>. For Windows 11 and newer, as well as for Mac users, you can unzip the file using the standard method.

Dataset riverine flood

Download the flood hazard maps of the world for different return periods. You need to download them separately from the following links:

- 10-year https://data.jrc.ec.europa.eu/dataset/jrc-floods-floodmapgl_rp10y-tif
- 20-year https://data.jrc.ec.europa.eu/dataset/jrc-floods-floodmapgl_rp20y-tif
- 50-year https://data.jrc.ec.europa.eu/dataset/jrc-floods-floodmapgl_rp50y-tif
- 100-year https://data.jrc.ec.europa.eu/dataset/jrc-floods-floodmapgl_rp100y-tif
- 200-year https://data.jrc.ec.europa.eu/dataset/jrc-floods-floodmapgl_rp200y-tif
- 500-year https://data.jrc.ec.europa.eu/dataset/jrc-floods-floodmapgl_rp500y-tif

Go to *Data access* and download the *GeoTiff image* for each return period.

A screenshot of a web page's "Data access" section. On the left, there is a vertical navigation menu with links for "Description", "Contact", "Contributors", "How to cite", "Keywords", and "Data access" (which is highlighted). The main content area is titled "Data access" and features a "GeoTiff image" section. This section includes a "DATA" icon, "Use conditions" and "Access conditions" text, a link to the "European Commission reuse notice", and a "No limitations" link. A prominent "Download" button with a download icon is located on the right side of this section. At the bottom right of the main content area, there is a "Description" dropdown menu.

Open your download folder and unzip the folders you have just downloaded. Save them in a folder you will remember.

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 - 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 outline the extent of your settlement or the area you intend to analyze. You can now define the boundaries of the settlement by left-clicking to set edge points. Complete the drawing by right-clicking.

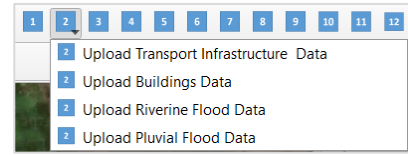


Make sure the *SettlementArea* Layer is selected by clicking on the layer name (not the check box) in the Layers Window.



Step 2 - Upload data

To choose the data to be used for the analysis, click the button **2** and execute all uploads one after the other. Transport Infrastructure, Buildings and Riverine Flood Data have to be uploaded. The order in which you upload the data does not matter.

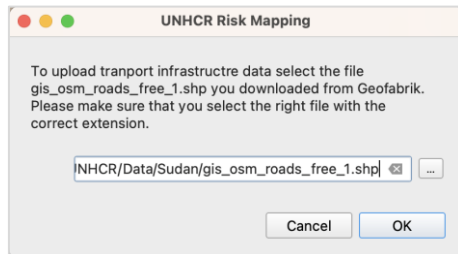


i For Pluvial Flood there is no global data available, and you can just skip its upload.

If you possess local knowledge about areas prone to Pluvial Floods, you can manually add them in Step 4.

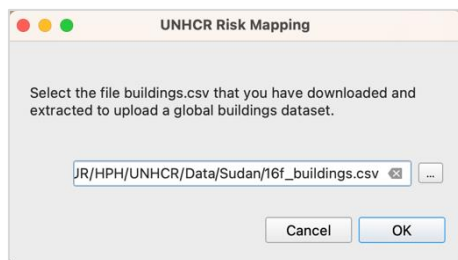
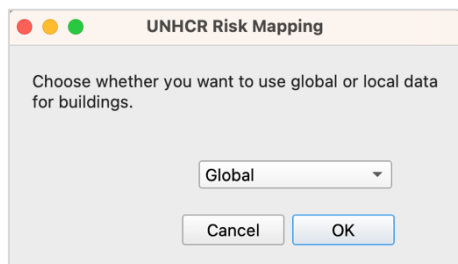
Transport infrastructure

To upload transport infrastructure data, select the shp-file you downloaded from Geofabrik and click OK.



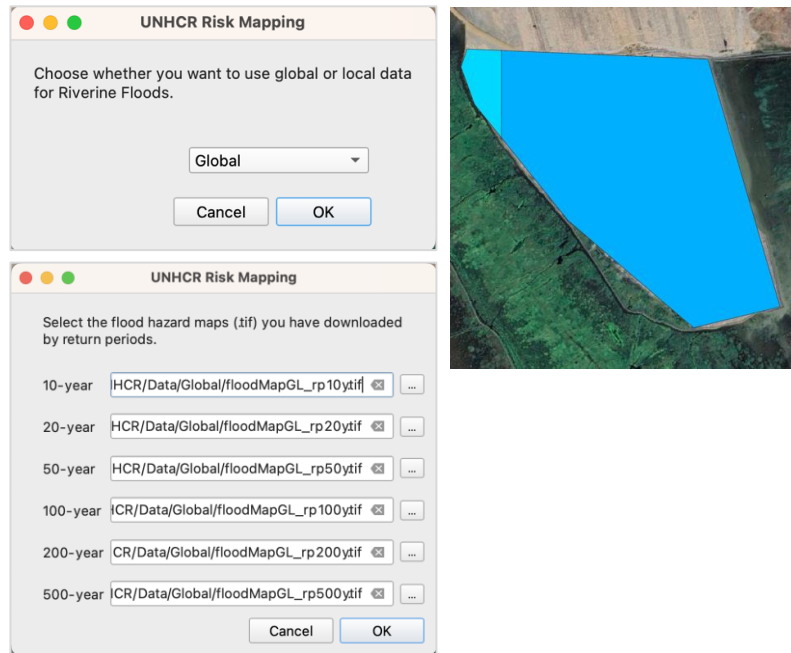
Buildings

To upload buildings data, opt for the global data upload option. Choose the csv-file you downloaded earlier and click OK.

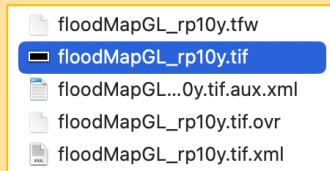


Riverine flood

To upload riverine flood data, select the global data upload option. Upload the tif-files corresponding to different return periods that you downloaded earlier.

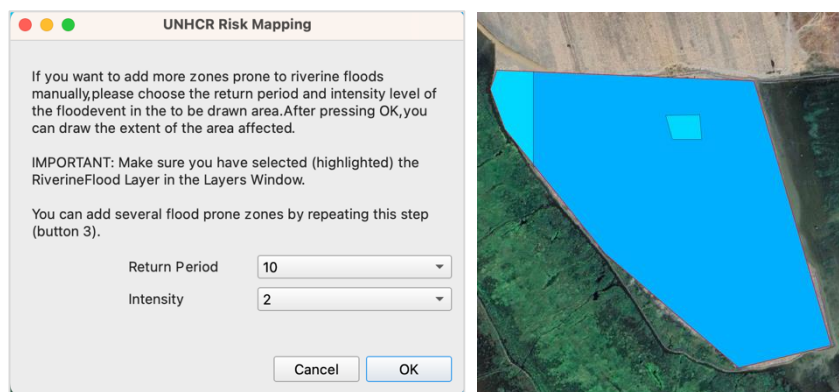


Please make sure that you select the correct file with the .tif extension, as indicated in the image below.



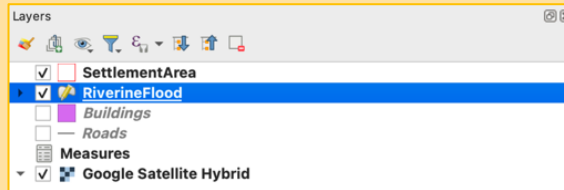
Step 3 - Riverine flood adjustment [optional]

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.



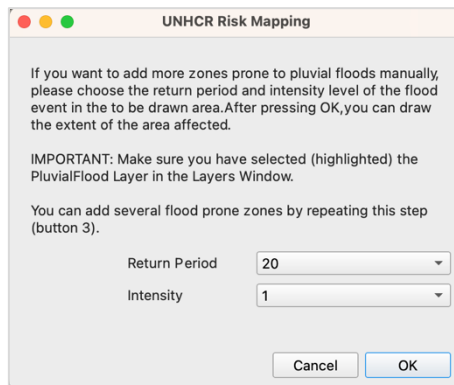
Add or adjust several flood prone areas by repeating this step.



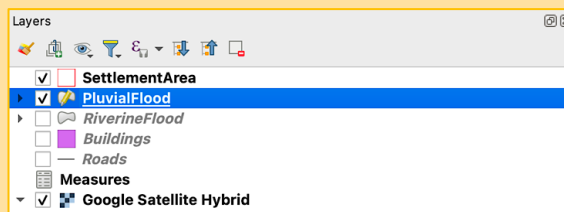
Find out more about Return Period and Intensity of a flood event in the **Overall Guide** under "Flood attributes".

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



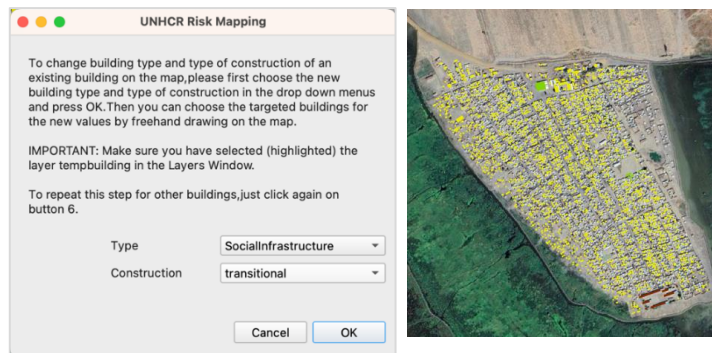
Add or adjust several flood prone areas by repeating this step.

Step 5 - Risk area calculation

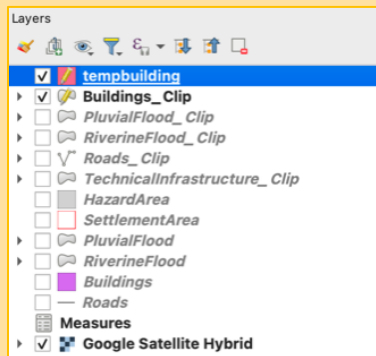
In the fifth step, the hazard areas and corresponding risk intensities are automatically calculated. You have the possibility to adjust the findings in later steps. Click on button **5** and press OK. Wait until the layers are added and the success message appears.

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.



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



You can adjust several buildings by repeating this step.

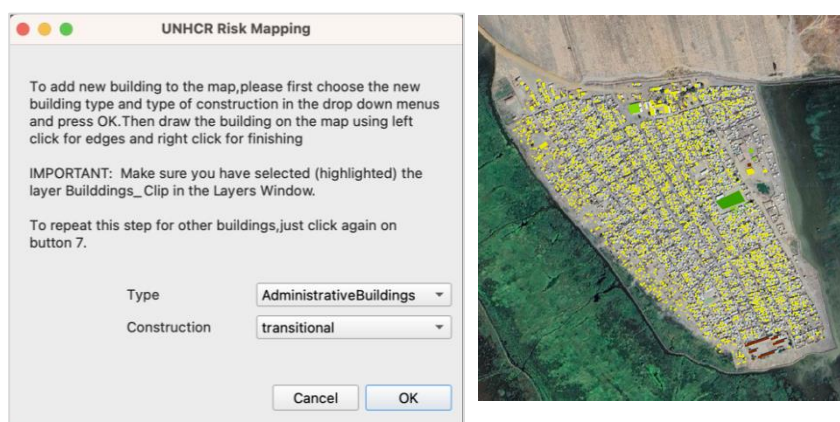
If you need to remove one or multiple preloaded buildings, please refer to the “QGIS Workarounds” section in the **General Manual** for detailed instructions.




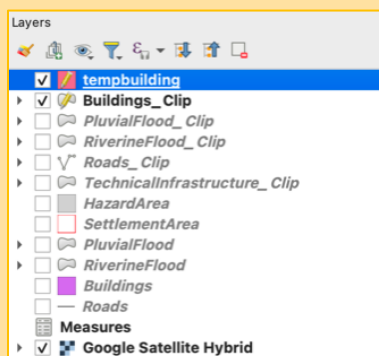
Find out more about Type and Construction of a building in the General Manual under “Types of vulnerable assets” and “Type of construction”.

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.



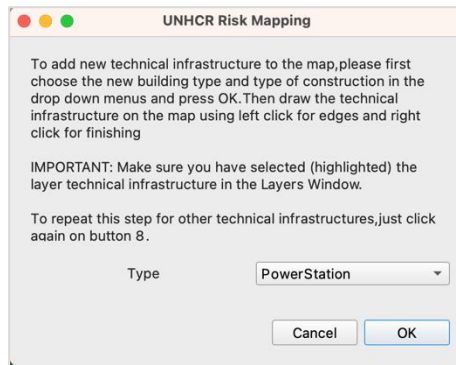
 Make sure the *tempbuilding* layer is selected by clicking on the layer name (not the check box) in the Layers Window.



 You can repeat this step for all missing buildings.

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.

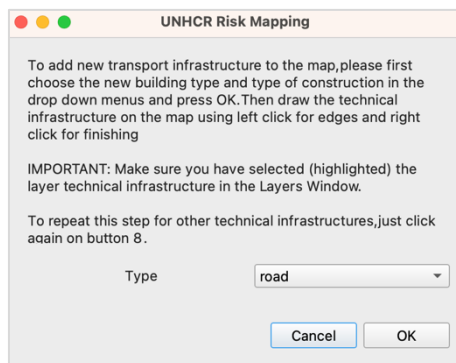



⚠ Make sure the *TechnicalInfrastructure* layer is selected by clicking on the layer name (not the check box) in the Layers Window.

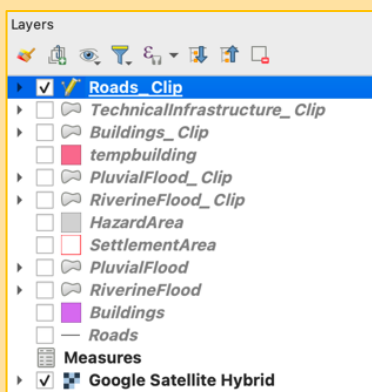
i You can repeat this step for all missing technical infrastructure.


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 transport infrastructure.


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

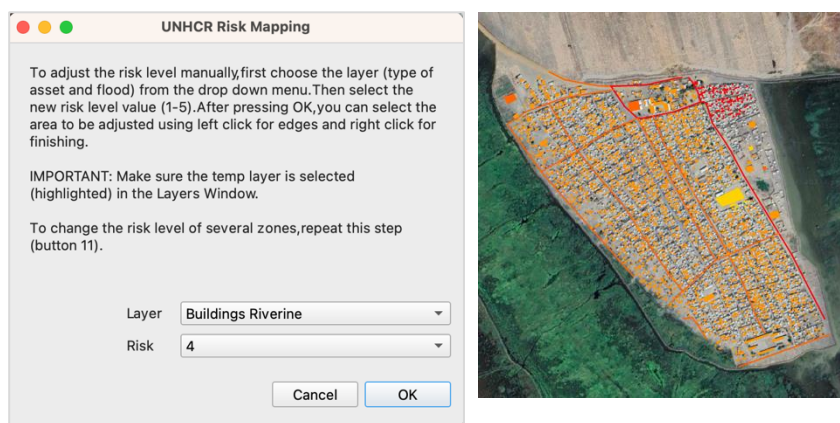
Step 10 - Calculate risks


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  and start the calculation by pressing *OK*. Wait until the layers are added and the success message appears.

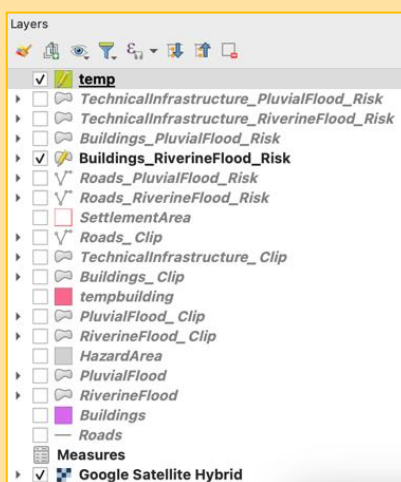



Step 11 - Adjust risk [optional]

To adjust the risk level manually, click on button . 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.





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



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

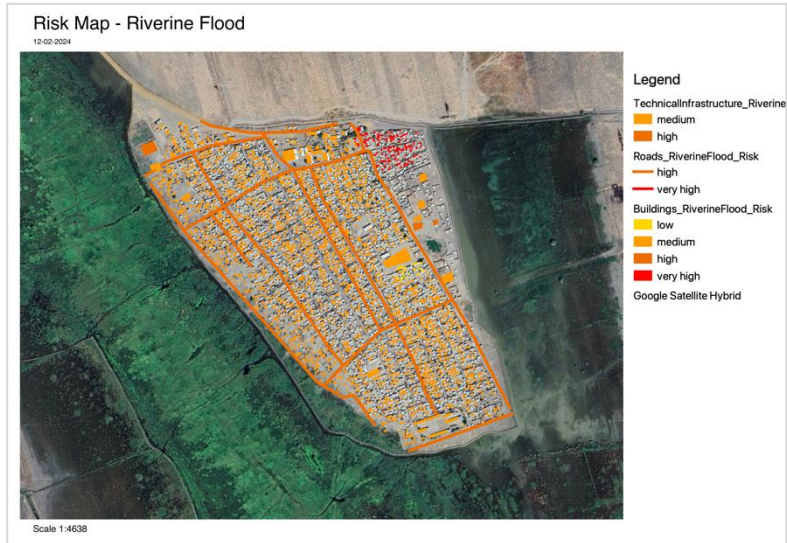
Step 12 - Export risk map

By pressing button  the Risk Maps will be exported as a PDF to the project-folder. If no areas prone to riverine floods are registered, only the “Output_RiskMap_Riverine” will be displayed.

 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.

-  Output_RiskMap_Pluvial
-  Output_RiskMap_Riverine




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.

UNHCR Risk Mapping

You can now filter the potential risk mitigation measures to be included in the risk mitigation strategy preferred characteristics of the measures in the different categories and press OK.

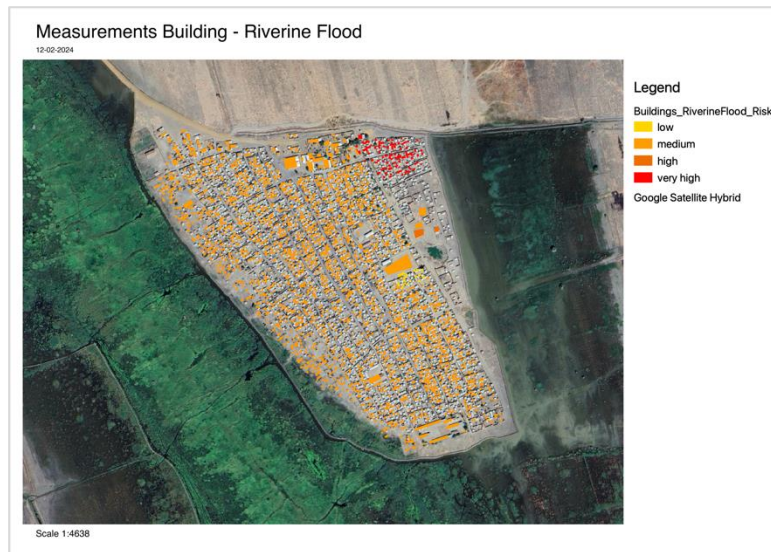
<p>Type of Interventic</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Engineered <input checked="" type="checkbox"/> Nature-Based <input checked="" type="checkbox"/> Hybrid <input checked="" type="checkbox"/> Non-Structural 	<p>Scale of Interventior</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Shelter-Plot-Block <input checked="" type="checkbox"/> Settlement <input type="checkbox"/> Supra-settlement 	<p>Targeted Natural Hazan</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Pluvial Flood <input checked="" type="checkbox"/> Coastal/Riverine Flood
<p>Targeted Vulnerable Asset</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Buildings <input checked="" type="checkbox"/> Transport <input checked="" type="checkbox"/> Technical Infrastructre <input type="checkbox"/> Land Cover 	<p>Strategy Type</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Relocate <input checked="" type="checkbox"/> Reduce Hazard Magnitude <input checked="" type="checkbox"/> Reduce Asset Vulnerability <input checked="" type="checkbox"/> Reduce Casualities 	<p>Implementation Tim</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Short (1 day - 1 month) <input checked="" type="checkbox"/> Medium (1 month - 1 year) <input type="checkbox"/> Long (> 1 year)
<p>Effect Duration</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Short-term (< 1 year) <input checked="" type="checkbox"/> Medium-term (1 year to 10 years) <input type="checkbox"/> Long-term (> 10 years) 	<p>Investment Costs</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Low <input checked="" type="checkbox"/> Medium <input type="checkbox"/> High 	<p>Maintenance Costs (yearly)</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Low (< 10% investment costs) <input checked="" type="checkbox"/> Medium (10-50%) <input type="checkbox"/> High (> 50%)

 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.

 Find out more about the categories in the Compendium.

Step 14 - Export risk maps including risk mitigation measures

Press button **14** to export risk maps, including the tables constituting the risk mitigation 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

In addition, an Excel file is generated, providing details on the quantity of assets categorized by asset type and flood type for a specified risk.

	Asset_Type	Asset	Flood_Type	Risk	Count
0	Buildings	AdministrativeBuildings	Riverine	3	3
1	Buildings	AdministrativeBuildings	Riverine	4	3
2	Buildings	Logistics	Riverine	3	24
3	Buildings	Logistics	Riverine	4	24
4	Buildings	OpenSpaces	Riverine	2	3
...					

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.