

# Exercise 4a: Generating a database of elements at risk from scratch

**Expected time:** 3.5 hours  
**Data:** data from subdirectory: /exercise04a  
**Objectives:** This exercise gives a methods for the generation of a database for the elements at risk within RiskCity, focusing on buildings and population. In this exercise it is assumed that no detailed building information is available, and the number of buildings has to be estimated based on the urban land use type and the average floorspace of buildings per land use type. Population estimates are made based on the building floorspace.

Risk assessment with GIS can be done on the basis of the following basic equation:  
**Risk = Hazard \* Vulnerability \* Amount of elements at risk**

In this exercise we are limiting ourselves to only the upper row : buildings and population. This is due to the limited time for the exercises. Also because in practice they are considered first. However, a complete risk assessment should also evaluate the direct and indirect impacts of the other types of elements at risk.

The elements at risk that may be affected by hazardous events are numerous, and can be classified in many different ways. The table below provides an example of such a classification.

<b>Physical elements</b> Buildings: Urban land use, construction types, building height, building age, total floor space, replacement costs. Monuments and cultural heritage	<b>Population</b> Density of population, distribution in space, distribution in time, age distribution, gender distribution, handicapped, income distribution
<b>Essential facilities</b> Emergency shelters, Schools, Hospitals, Fire Brigades, Police,	<b>Socio-economic aspects</b> Organization of population, governance, community organization, government support, socio-economic levels. Cultural heritage and traditions.
<b>Transportation facilities</b> Roads, railway, metro, public transportation systems, harbor facilities, airport facilities.	<b>Economic activities</b> Spatial distribution of economic activities, input-output table, dependency, redundancy, unemployment, economic production in various sectors.
<b>Life lines</b> Water supply, electricity supply, gas supply, telecommunications, mobile telephone network, sewage system.	<b>Environmental elements</b> Ecosystems, protected areas, natural parks, environmentally sensitive areas, forests, wetlands, acuifers, flora, fauna, biodiversity.

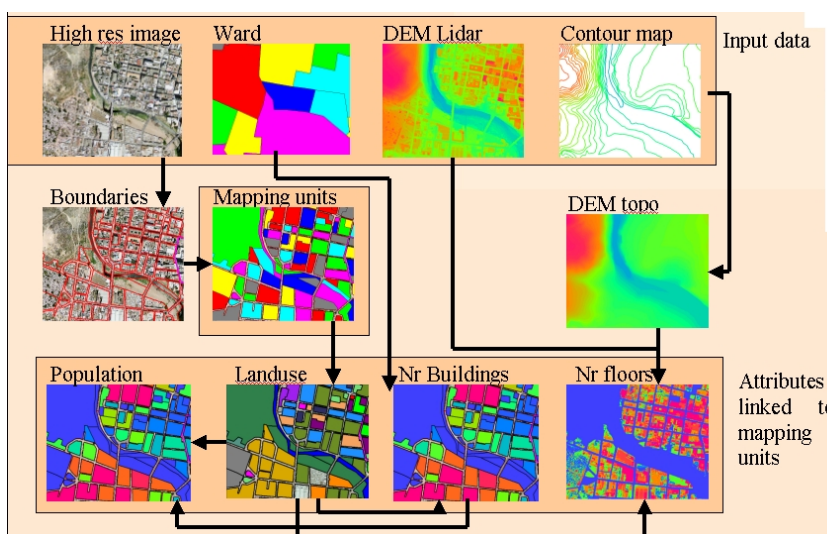
The basic unit for risk assessment we will use in this exercise is the so-called **mapping unit**. It consists of a number of buildings, and can be compared with a city block, or a census tract. The area within a mapping unit can be considered as more or less homogeneous, and the buildings have more or less the same urban land use, and the same building type. We do not carry out risk assessment for individual buildings because the hazard and vulnerability information is not detailed enough to do that at such a detailed level.

Depending on your interest in the topic you may select to either do Exercise 4a (creating a database by starting from scratch), or Exercise 4b (creating a database with available footprint information). You can also decide to do both exercises, although that might perhaps take a bit too much time

## Input data

The following input data gives an overview of the thematic data and how they are derived.

Name	Type	Meaning
<b>Image data</b>		
<b>High_res_image</b>	Raster image	This represents a high resolution color image derived from an IKONOS image. It has been orthorectified, and the panchromatic band is fused with the color bands, and resampled to 1 meter.
<b>Elevation data</b>		
<b>Altitude_dif</b>	Raster map	This is a map showing the difference in elevation between the Lidar Digital Surface Model which has been derived from a laser scanning flight, and the Digital Elevation Model derived from contour interpolation. The values in the map show the height of the objects in the area.
<b>Elements at risk</b>		
<b>Unit_boundaries</b>	Segment map	A segment map of the boundaries of the mapping units (city blocks) that will be used as the basis for the creation of the polygon map.
<b>Mapping_units_points</b>	Point map	A point map with a point in each mapping unit, with a unique identifier that can be used to polygonize the segment map <b>Unit_boundaries</b> .
<b>Mapping_units</b>	Polygon map and table	This map represents the mapping units used for elements at risk mapping, but now as polygons. Each of the mapping units has a unique identifier, so that in the accompanying table information can be stored for each unit. The units may be individual large building or plots with a specific landuse, although they are mostly grouping a number of buildings. In the accompanying table information is given on the number of buildings and number of people
<b>Building_map</b>	Raster map	Building footprint map of the city prior to the 1998 Mith event. The map still contains the buildings that were destroyed by landslides and flooding during the Mitch event
<b>Building_map_segments</b>	Segment map	Boundary lines of all buildings in the area.
<b>Wards</b>	Polygon map	A polygon map representing the administrative units within the city. In the accompanying table information is given on the number of buildings and number of people based on a recent census.
<b>Roads</b>	Segment map	A segment map of the streets, roads and paths, made by digitizing from topographic maps.



The database generation is done using the procedure shown below. Central in the database is the map **Mapping\_units**, derived from boundary lines that are screen digitized on top of the high resolution image. The attribute information linked to this map is related to urban land use (interpreted from the image), the number of buildings (either obtained from an existing building footprint map, or otherwise estimated from the image), the height of buildings (obtained from Lidar and topo DEMs). The building map is finally used to estimate the population distribution.

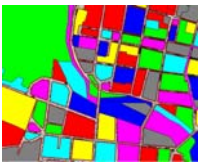
In this case study we only take into account two types of elements at risk: buildings and population. Building information could be obtained from existing cadastral databases, and population data from census database. However, in many cities in developing countries such data are not available, or are restricted, or are not in a digital format. When these data are not available they should be collected. However, the generation of a building database in GIS is a very time-consuming procedure. When high-resolution data sets are available, such as in this exercise, we can use them for interpretation, and the basic mapping units can be digitized on the screen.

## Screen digitizing the mapping units

As mentioned earlier we base the risk study on so-called mapping units, which consists of a series of buildings, with more or less the same landuse pattern. In exercise we will concentrate on the mapping of the basic units for the urban risk assessment. There are two files in the dataset that are most important for that:



- **Unit boundaries:** this contains the boundary lines of the mapping units that will be used as basic units for the elements at risk. It has been made through screen digitizing on the high-resolution image. The segments of the street pattern have been used as the basis for the screen digitizing.



- **Mapping\_units:** These polygons represent the mapping units used for elements at risk mapping, but now as polygons. Each of the mapping units has a unique identifier, so that in the accompanying table information can be stored for each unit. The units may be individual large building or plots with a specific landuse, although they are mostly grouping a number of buildings.

We start with the actual screen digitizing the segment of the mapping units. It is possible to do that in three ways:

1. On top of the **High\_res\_image**. In this case you will not be able to see stereo, which is a disadvantage in the interpretation. However, you are able to see a lot of detail and the color also adds to it.
2. On top of a color stereo image. This is the best way, but you will need a screen stereoscope for that, so not possible now
3. On top of the anaglyph stereo image **Anaglyph**. You will need anaglyph glasses for the interpretation. The problem is that the lines will not exactly match with the features in the image.

Let us start by using option 1:



- Open the raster image **High\_res\_image**.
- On the **Layer** Menu, go to **Add Layer** and select the **Unit\_boundaries** segment map.
- Now you can view the segments of the different mapping units in the study area. As you can see the mapping units are mostly bounded by the streets.
- You can also see that there are two areas indicated by a thick line that do not yet have unit boundaries: one in the center of the city and one near the river. Zoom in on the part in the city center, indicated by the purple line. You can see that the mapping units are still lacking
- In the map window of **High\_res\_image** select *Edit / Edit layer* and select the segment map **Unit\_boundaries**

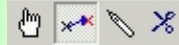
As you can see it may not always be so easy to digitize the mapping units, because the buildings are of different sizes, and the shadows of the buildings also play a role.



Figure: Left: High-resolution image and right segments of mapping units. One new segment has been added.



- You can use the on-screen-digitizing functionality to create the boundary of the mapping units inside it. Given the resolution of the imagery available, it will be very difficult to digitize individual buildings (also because there are just too many). If the building is large enough, you may also decide to map individual buildings. Also digitize vacant land. Use the pen in the editor menu to digitize.



- Make sure that the lines are given the code: **Unit\_boundaries**
- When you finish digitizing one segment, select the segment with the *Select Mode* icon (the hand) and choose the correct class. Next select the *Insert Mode* icon (the pencil) and digitize the following segment.


The image that you see when digitizing the blocks in the center of the city is shown in the figure below.

It doesn't matter if you do not finish the exercise. The aim of this exercise is just to make you aware how the mapping units have been defined



Figure: Right: completed section of digitized mapping units



- After finishing (part) of the digitizing, go to the *File* menu and select *Check Segments*. Select *Self Overlap*. Repair the mistakes. Ask a teacher to assist you the first time, if you have no experience with it.
- Then check segments using *Dead Ends*, and *Intersections*. Repair all mistakes.
- Close the map editor (using the symbol ) , and close the map window. Compare the results of the digitizing with that of your neighbors.

After digitizing the segments of the boundaries of the mapping units, the next step would be to create polygons from them. This polygonization procedure takes more time, because the segments should be checked for errors, and in each polygon there should be a point with an Identifier domain, indicating the number of the mapping unit. This procedure takes a bit too much time to do this right now.

### Polygonize from segments.

- We will not do the actual polygonization of the segments now because that might take to much time, as you will have to edit the segment map. For that you have to make sure that all the segments are digitized, and that they connect to each other, without overlaps or dead ends. This is done through checking the segments in the segment editor. After all segments are OK, the next step is to select *Operations, Vectorize, Segment to Polygons*. Instead of having digitized the points within the mapping units with a unique identifier, it is also possible to do this automatically. Select the option *Unique Identifiers* in the operation window *Segments to Polygons*. This will result however, in a random selection of identifiers. The resulting polygon map will have different identifier than the polygon map **Mapping\_units** which is already in the dataset. Make sure to name the output polygon file differently, e.g. **Mapping\_unit\_polygons**. Urban land use.
- You can also use pre-existing points in the segment to polygon operation. We have generated the points for you, in the point map **Mapping\_units\_points**.

## Estimating urban land use from image interpretation

In the exercises we generate a database where the polygon map


**Mapping\_units** is the central map, and attribute information is stored for the following attributes:

- Urban land use
- Percent vacant area
- Number of buildings
  - With 1 floor
  - With 2 floors
  - With 3 floors
  - With > 3 floors
- Population
  - Daytime
  - Nighttime

After you have had an idea on how the segments were made using screen digitizing, and how these were used to generate polygons, let us look at the attributes that can be obtained. In the following exercises we will estimate these attributes. We start by estimating the urban land use. The vulnerability assessment will be largely based on the urban land use mapping, which will be combined with other information such as the number of buildings, and the height of the buildings.

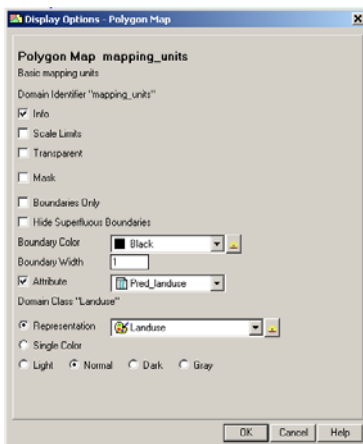
For the multi-hazard loss estimation the urban land use is very important, as we can later define the population amount which might be in the mapping unit at a particular time of the day. That is why it is important to differentiate between the land use types that would have different activity patterns, at the same time of the day. For example, in residential areas, the population is supposed to be highest during the night, and lowest during the day, whereas in office buildings and schools it is reverse. On the other hand there are landuse types that have a very large number of people during a small period (e.g. stadium, religious buildings). Also it is important to map the areas that normally have no people (e.g. vacant areas). For the land use classification we have made the following legend (in ILWIS terms called a "domain").



- \* Open the domain **Landuse** , (  )
- \* Check the various classes, and discuss with your neighbour whether you would like to include other classes
- \* In the table below, indicate the importance of a number of the classes for characterizing the population and building vulnerability.

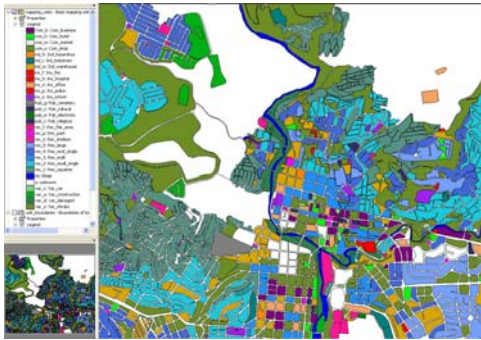
Name	Code	Description	Important because
Com_business	Com_b	Business offices	
Com_hotel	com_h	Hotels	
Com_market	com_m	Commercial area: market area	
Com_shop	com_s	Commercial: shops and shopping malls	
Ind_hazardous	ind_h	Hazardous material storage or manufacture	
Ind_industries	ind_i	Industries	
Ind_warehouse	ind_w	Warehouses and workshops	
Ins_fire	ins_f	Fire brigade	
Ins_hospital	ins_h	Hospitals	
Ins_office	ins_o	Office buildings	
Ins_police	ins_p	Police station	
Ins_school	ins_s	Institutional : schools	
Pub_cemetery	Pub_g	Cemetery	
Pub_cultural	pub_c	Institutional: cultural buildings such as museums, theaters	
Pub_electricity	pub_e	Electricity installations	
Pub_religious	pub_r	Religious buildings such as churches, mosques or temples	
Rec_flat_area	rec_f	Recreational: flat area or football field	
Rec_park	rec_p	Recreational: park area	
Rec_stadium	rec_s	Recreational : stadium	
Res_large	res_5	Residential: large free stading houses	
Res_mod_single	res_4	Residential, moderately sized single family houses	
Res_multi	res_3	Residential: multi storey buildings	
Res_small_single	res_2	Residential, small single family houses, mostly in rows	
Res_squatter	res_1	Residencial, low class houses: squatter areas	
River	riv	River	
unknown	u		
Vac_car	vac_c	Vacant : car parking and busstation	
Vac_construction	vac_u	Vacant area which is prepared for building construction	
vac_damaged	vac_d	Area recently damaged by hazard events	
Vac_shrubs	vac_s	Vacant land with shrubs, trees and gress	

Having done this, let us now look more closely to the map **Mapping\_units**, and you can define what the landuse should be yourself by interpreting the characteristics of the image.



\* Open the polygon map **Mapping\_units**. If you click on one of the polygons, you can see that each of them has a unique identifier, so that it is possible to give each of them different attributes, which come from the attached table.


\* Click with the right mouse button in the map, and select *Display Options*, and select **1 pol mapping\_units**. The *Display Options* window opens again. Now select the option *Attribute*, and make sure the option **Pred\_landuse** (predominant landuse) is selected. Select representation: **Landuse**. Now the map is displayed again, but now with the colors representing different land use types. Check this with the legend on the left. There are a number of white areas, which have been left open, and for which the landuse still needs to be indicated.



The map is now shown with white areas that do not have any land use classification. You can now use the information from the high resolution image to decide what is the most likely landuse type. For instance you can easily define the vacant areas, and the areas that have been damaged by the recent flood and landslide disasters that occurred in the area. If you look closely you can also find evidence in the city centre that there are religious building (e.g. churches), commercial buildings (e.g. market place), different types of residential buildings (e.g. those with single houses in gardens, houses in rows, squatters etc).

Try to estimate the urban landuse for a number of the white areas in the map yourself.

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- \* Select *Layers / Add layers* and add the raster image **High\_res\_image**. Now you can see that the high resolution image is shown for the areas which are not coded.
- \* Zoom in on one of the areas without a land use class, and double click in it. The attribute window is now opened, and the attribute **Pred\_Landuse** is indicated: **unknown**. Click in this window on the name unknown. You can now open a list of other possible land uses. Select the one you consider right, and double click on another polygon.
- \* If you click the  button, you will see that the map is updated and the polygon will become colored.
- \* Zoom in on another unclassified area, and select again the right landuse.
- \* Do this for a number of the polygons that don't have a land use code yet.
- \* Which of the land use classes are most difficult to decide?

Answer:

In reality you might have to carry out fieldwork to better characterize urban land use, or you might have an existing land use map. These are however, often too general in terms of the categories used.

Land use type	Image characteristics that you used to classify the urban land use class

## Estimating the number of buildings

The number of buildings per mapping unit is also a very important attribute that is required for risk assessment. The estimation of the number of buildings per mapping unit can be done in two ways, considering the situation of a data poor environment:

- An accurate way is to actual count the number of buildings for all mapping unit from the high-resolution image. However, this would cost an enormous amount of time and is not very feasible.
- A less accurate way is to make a number of samples per mapping units for each land use type and count the number of buildings. Then the average building size is calculated, and for those mapping units where no samples were taken these average building sizes are used in combination with the area of the mapping unit to estimate the number of buildings.

We will follow the second method here. We did the sampling for you (lucky for you), and counted for a number of mapping units (approximately 140) the number of buildings. The sampled mapping units are stored in the table **Buildings\_sampled**.

The accuracy of this method depends on the amount of samples that you make, and the amount of field checks you make. So as such the method might lead to good results in a data poor environment.

- Open the table **buildings\_sampled**.

The table has the following columns:

- **Pred\_landuse**: the urban land use that you estimated in the previous exercise
- **Buildings sampled**: an indication of the number of buildings that was manually counted in some of the mapping units. This was done directly from the high resolution image.

As you can see most of the records of Buildings samples have a ?, meaning that they are not sampled. Those that have a 0 value do not have buildings, as can be deduced from the urban landuse (vacant). We will now use some steps to make a rough estimation of the number of buildings for each mapping unit. We do this by making the following assumptions:

- **Step A:** We can calculate the average area of buildings for the mapping units that were sampled.
- **Step B:** We assume that buildings in the same land use class have more or less the same area.
- **Step C:** We then divide the area of the mapping units that were not sampled by the average building area to obtain a rough estimation of the number of buildings.

	Pred_landuse	Area	Buildings_sampled
nr_1	Res_mod_single	8782	?
nr_10	Res_mod_single	5471	?
nr_100	Res_squatter	2621	?
nr_100	Res_small_singl	7371	?
nr_100	Com_shop	3152	20
nr_100	River	2830	0
nr_100	Res_squatter	862	?
nr_100	Rec_flat_area	7745	0
nr_100	vac_damaged	2246	0
nr_100	vac_damaged	6805	0
nr_100	vac_damaged	18396	0
nr_100	Res_squatter	864	?

The ILWIS procedure to do this is given below:

In the procedure we make use of several ILWIS tools: Table operations including table calculations and aggregate functions.

**Map and Table Calculation:**  
 ILWIS has two options for calculation:  
**Map calculation**, where the output is always a map. You type the formulas in the command line of the main window.  
**Table calculations** where the output is always a column. You type the formulas in the command line of the table window.  
 The syntax for both types of calculations is very similar.  
 Check on the ILWIS HELP for an overview of the operators and functions used in map and table calculation.  
 Check for instance the use of the **conditional IFF function** and the logical operators (**and, not, or, xor**).



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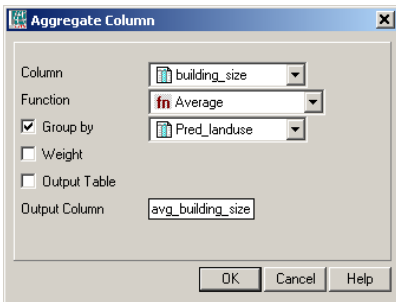
- Open the table **buildings\_sampled**.
- **Step A:** Use the following formula to calculate the building size in the mapping units, where samples were taken.

**building\_size:=iff(buildings\_sampled=0,0,area/ buildings\_sampled)**

Use a precision of 1.

This formula means “if the value in the column **building\_sampled** is 0 (meaning that the areas are vacant and don't have buildings) then the resulting building size is 0. If not divide the area by the number of buildings sampled. Now for all sampled mapping units we have calculated what the building size was.

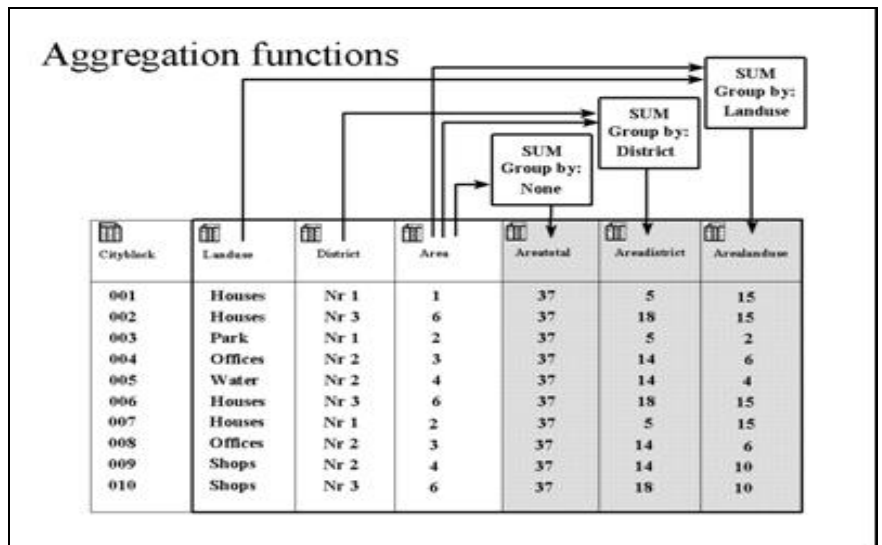
- **Step B:** Now we want to know the average building size per land use . Select *Columns / Aggregation*. Select the column **Building\_size**, and the function *Average*. Group by **Pred\_landuse**. Name the output column: **avg\_building\_size**. See the example screen.



**Aggregation functions.**

They aggregate the values of a column in the current table. The following aggregation functions are available: Average, Count, Maximum, Median, Minimum, Predominant, Standard deviation, Sum.

- All aggregation functions can be used to aggregate the values of a whole column: you obtain one output value. For all records, the same aggregation value will appear.
- All aggregation functions can be used to aggregate values in a column per group: use a '**group by**' column. Then, for all records that have the same class names or IDs in the selected 'group by' column, the same aggregation value will appear.
- The Average, Median, Predominant and Standard Deviation functions can be used to calculate weighted averages, etc.: use a weight column.
- If you do not select a 'group by' column, you will obtain one output value.
- If you also select a 'group by' column, you will obtain one aggregation value per group.





- **Step C:** Use the following formula to estimate the number of buildings for all units:  

$$\text{nr\_buildings} := \text{iff}(\text{isundef}(\text{buildings\_sampled}), \text{area}/\text{avg\_building\_size}, \text{buildings\_sampled})$$

Use a precision of 1.

This formula means: if the column `buildings_sampled` is undefined (has no value) than we divide the area of the mapping unit by the average building size (based on the same land use). If the column `Building_sampled` is not undefined, then we use the information from the column: `buildings_sampled`.

**Undefined values in ILWIS can mean several things:**

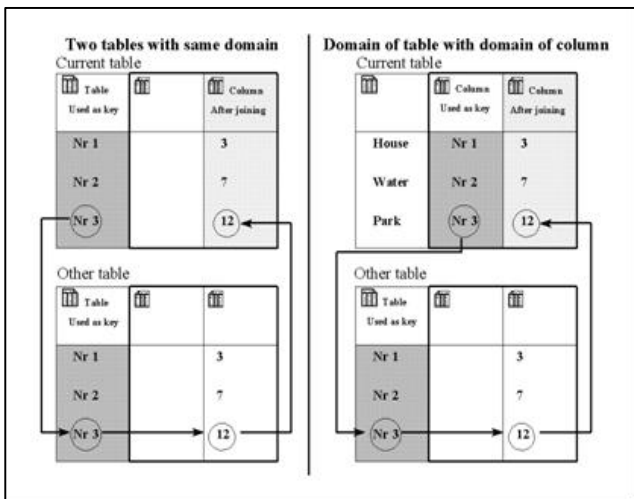
- No data is available for a pixel.
- A pixel is located outside the study area.
- The result of calculation was wrong (for example if the formula is wrongly made).
- Calculated values in an output map fall outside the value range defined by the output range values.

**Isundef()** function tests whether a field in the column or a unit in a map is undefined or not known. Check the ILWIS guide for further explanation.

Now we can bring in the number of buildings that we have calculated in the table **Buildings\_sampled** into our standard table that is linked to the map we use in risk assessment: **mapping\_units**. We use the operation: table joining for that.



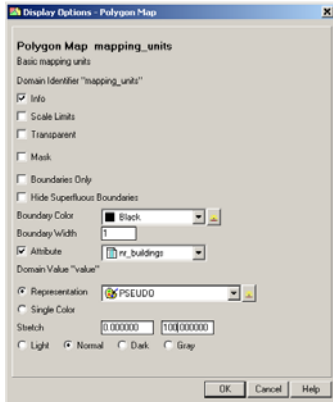
- Close the table **Building\_samples** and open the table **Mapping\_units**.
- Select *Columns / Join*, and join with the table **Buildings\_sampled**, and select in the column **Nr\_buildings**



The figure shows two different ways of table joining. Dark shaded columns are used as key. The arrows indicate how the link is made. Left: The domain of the current table is the same as the domain of the other table from which you want to join a column. Right: The domain of a column in the current table is the same as the domain of the other table from which you want to join a column. The easiest way to join columns from another table into a current table is to use the Join Column wizard. The wizard needs to know the table name from which you wish to get a column, the name of the column that you wish to join from that table into the current table, and the relation or link between the two tables. This link is made via a common domain that is used either by the tables themselves or by a column in the tables. This link or key, through which a join can be performed, should be a (common) Class or ID domain.

We can now display the results.

- Open the map **Mapping\_units**, and display the attribute **Nr\_buildings**. Stretch between 0 and 100 (first make sure that you change the properties of the polygon map **Mapping\_units**, and link to Attribute: **Mapping\_units**). Overlay the high resolution image.
- Evaluate the results by comparing the number of calculated buildings with those that you can see in the image



Naturally, if you check the actual number of buildings, the values of the estimated number of buildings will not be the same as the actual ones, because there may be exceptionally large or small buildings in the same landuse. It also doesn't consider the presence of vacant areas within the mapping units. We will check the accuracy of this method in section 3.2.

## Estimation of population distribution

In this analysis of population distribution we assume standard number of people per building for different land use type. We ignore the fact that larger buildings have more people.


Once we have estimated the number of buildings we can also estimate the population per mapping unit. Also here we assume that we do not have any other available data, such as population census data for the study area. We have to assume an average number of people per building, which depends on the land use type, as office buildings have more population than single houses. This information is already provided in the table **Landuse**. We can also calculate the population for a daytime and a nighttime scenario. For that we have also added two columns indicating the percentage of population that would be present in each type of building during the day and during the night.

- Open the table **Landuse** and check the values for the three columns: **Person\_building**, **Daytime** and **Nighttime**.

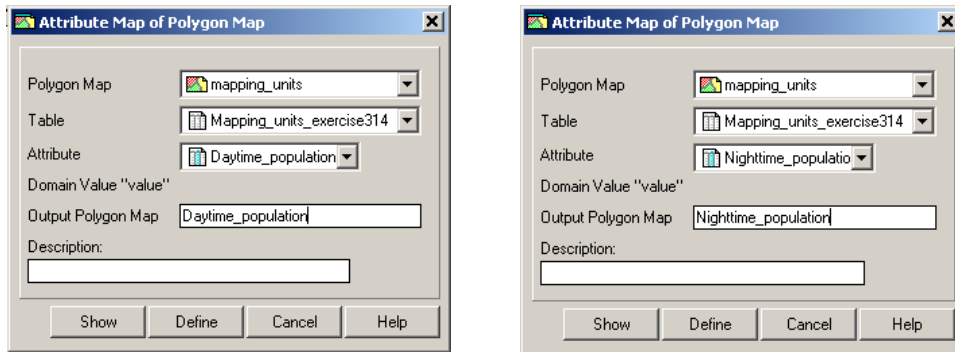
The table indicates the average number of people that would be in a typical building of a particular land use class. For instance, a building in a squatter area has an average of 7 people, whereas a large residential building has approximately 5 people. These value indicate the maximum number of persons that would be in a building. Depending on the day or night scenario these values would be multiplied by a factor, which would decrease these. For instance commercial buildings would be at full capacity during the day, and be empty during the night .

Make your own evaluation of the number of people and the daytime and nighttime factors that you find appropriate. You can of course simply agree with our estimates...

Land use class	Our estimation			You estimation		
	People per building	Daytime	Nighttime	People per building	Daytime	Nighttime
Com_business	20	1	0			
Com_hotel	100	0.1	1			
Com_market	1000	1	0			
Com_shop	10	1	0			
Ind_hazardous	10	1	0			
Ind_industries	25	1	0			
Ind_warehouse	20	1	0			
Ins_fire	25	1	1			
Ins_hospital	800	1	1			
Ins_office	100	1	0			
Ins_police	50	1	1			
Ins_school	300	1	0			
Pub_cemetery	0	0	0			
Pub_cultural	200	0	1			
Pub_electricity	0	0	0			
Pub_religious	500	1	0			
Rec_flat_area	0	0	0			
Rec_park	0	0	0			
Rec_stadium	20000	0	0			
Res_large	5	0.2	1			
Res_mod_single	6	0.2	1			
Res_multi	20	0.2	1			
Res_small_single	6	0.2	1			
Res_squatter	7	0.3	1			
River	0	0	0			
unknown	0	0	0			
Vac_car	0	0	0			
Vac_construction	0	0	0			
vac_damaged	0	0	0			
Vac_shrubs	0	0	0			



- We can now read in these three columns into the table **Mapping\_units\_exercise314**. (We have already calculated the number of buildings resulting from the previous exercise in this table). Open this table and use the join operation with the table **Landuse** for that. Read in the columns **Person\_building**, **daytime** and **nighttime**.
- Now it is simply a matter of multiplying the number of buildings with the population per building and the correction factor for day- or nighttime.
  - Daytime\_population:=nr\_buildings \* person\_building \* daytime**
  - Nighttime\_popultion:= nr\_buildings \* person\_building \* nighttime**
  - (make sure to use a precision of 1, as we cannot have half a person)
- Display the results (make sure to link them with the map in the properties of the the map **Mapping\_units**), and check the pattern.
- Also make attribute maps of both. In the catalog right click on the polygon map **mapping\_units**, then select *vector operations, attribute map*. Select the table **Mapping\_units\_exercise314**, the attribute Daytime and call the output map **Daytime\_population**. Do the same for the **Nighttime\_population**. See the image below



Answer:

Is there an accurate division of population if you compare daytime and nighttime? What could be the reason? How could this be improved?

Period	Total population
Daytime	
Nighttime	
Difference	

**Pocket Line Calculator:**

To temporarily view the outcome of an expression, without storing the results in a column, you can use the command line as a Pocket line calculator. On the command line type a "?" followed by an expression.



- You can read the total Daytime and Nighttime population in the table **Mapping\_units\_exercise314**, activating the statistic pane in *view, statistic pane*, and reading the value **sum** under the column **Daytime\_population** and **Nighttime\_population**.
- For the evaluation of the difference you can use a generic calculator or typing directly in the command line of ILWIS the following formula:

**?183779-143379**

Now you have generated a basic elements at risk database from scratch, basically only based on the interpretation of a high resolution image.