

MOBILISATION DES EAUX SOUTERRAINES POUR L'ALIMENTATION EN EAU POTABLE A ZAHLÉ – LIBAN

AIDE À LA DÉCISION

Assessment of Soil vulnerability and potential
for rain water management in Zahle area

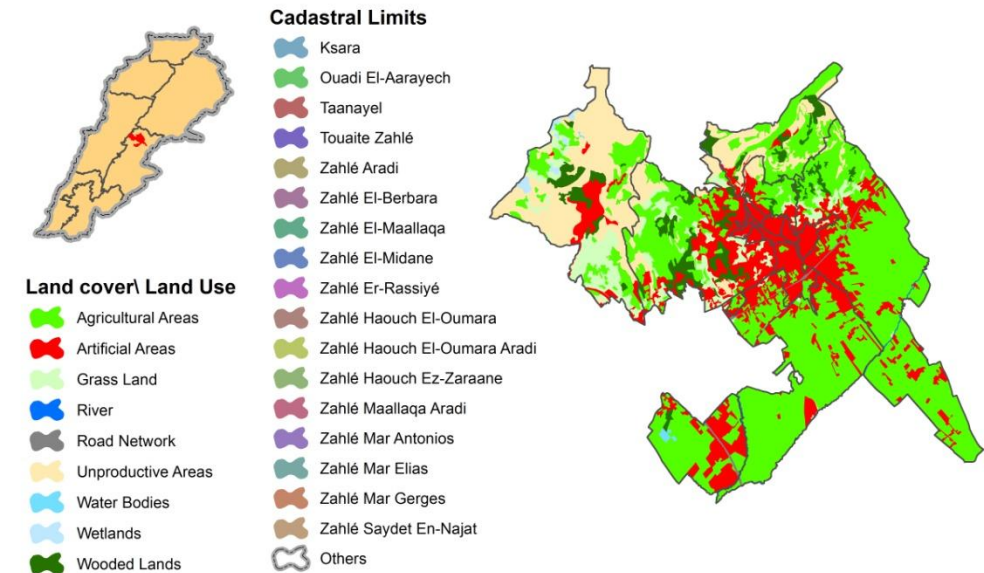
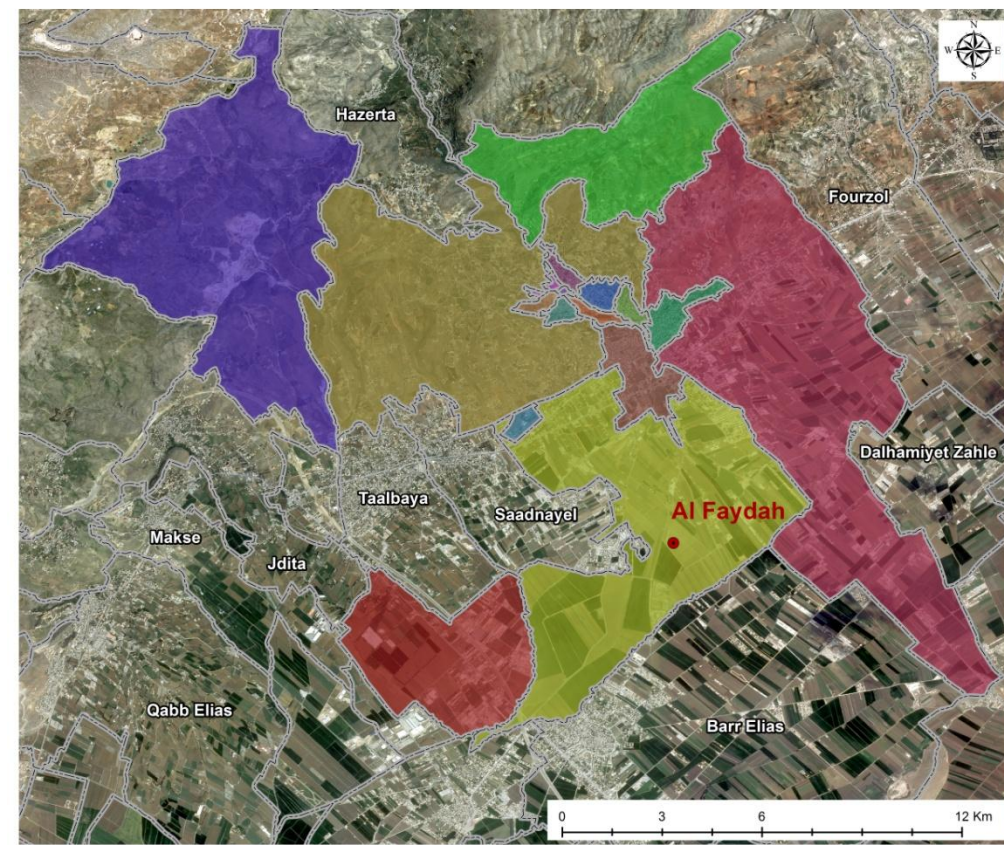
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Objective

- Evaluate soil permeability for qualitative and quantitative water protection and potential transfer of soluble pollutants to groundwater.
- Assess potential rainwater immediate capture and filtration (harvesting within the soil) in relation to soil quality; in order to alleviate non-point or diffuse pollutions downstream.
- Assess the environmental hazards like soil erosion, landslide and soil vulnerability to pollution.

Study Area

- The study focus on Zahle, Central Bekaa area.
- Distributed over 17 Cadastral areas.
- Artificial zone is mainly located at the center of the study area.
- The agricultural sector Fall in the upper northern and lower part the piedmont.

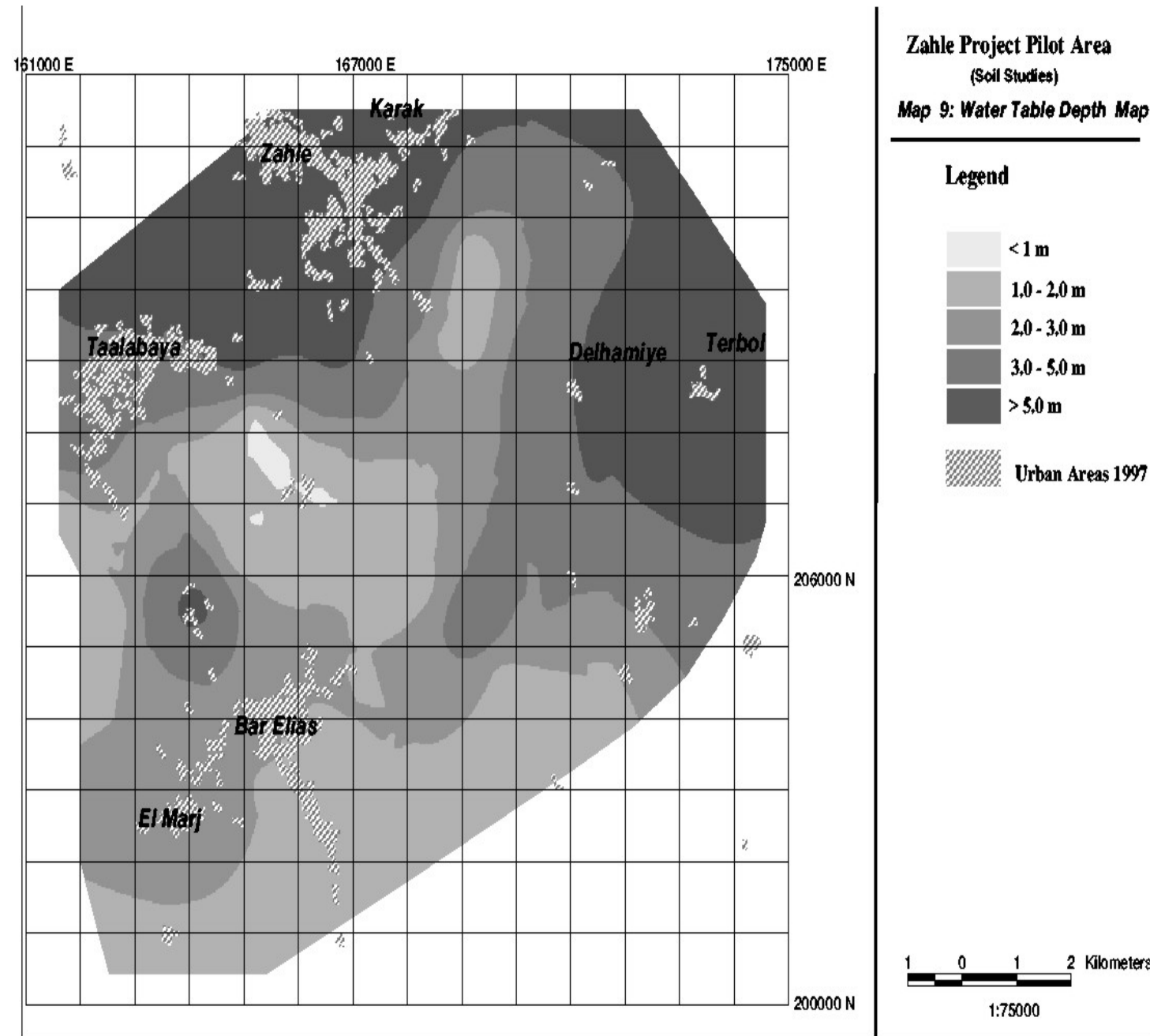


Study Area

- The geomorphological features of the Berdaouni Watershed represent a variety of slopping and steep lands in the upper part and level plain in the lower part.
- It has low to medium permeability lithological formations, covered by quaternary substratum and semi permeable, fine gravely, sediments forming the soil cover.

Study Area

- The soil types in the area of study have different texture and permeability.
- Shallow depth of water table in the foot slopes/Bekaa plain areas with water table depth <1-5 m.



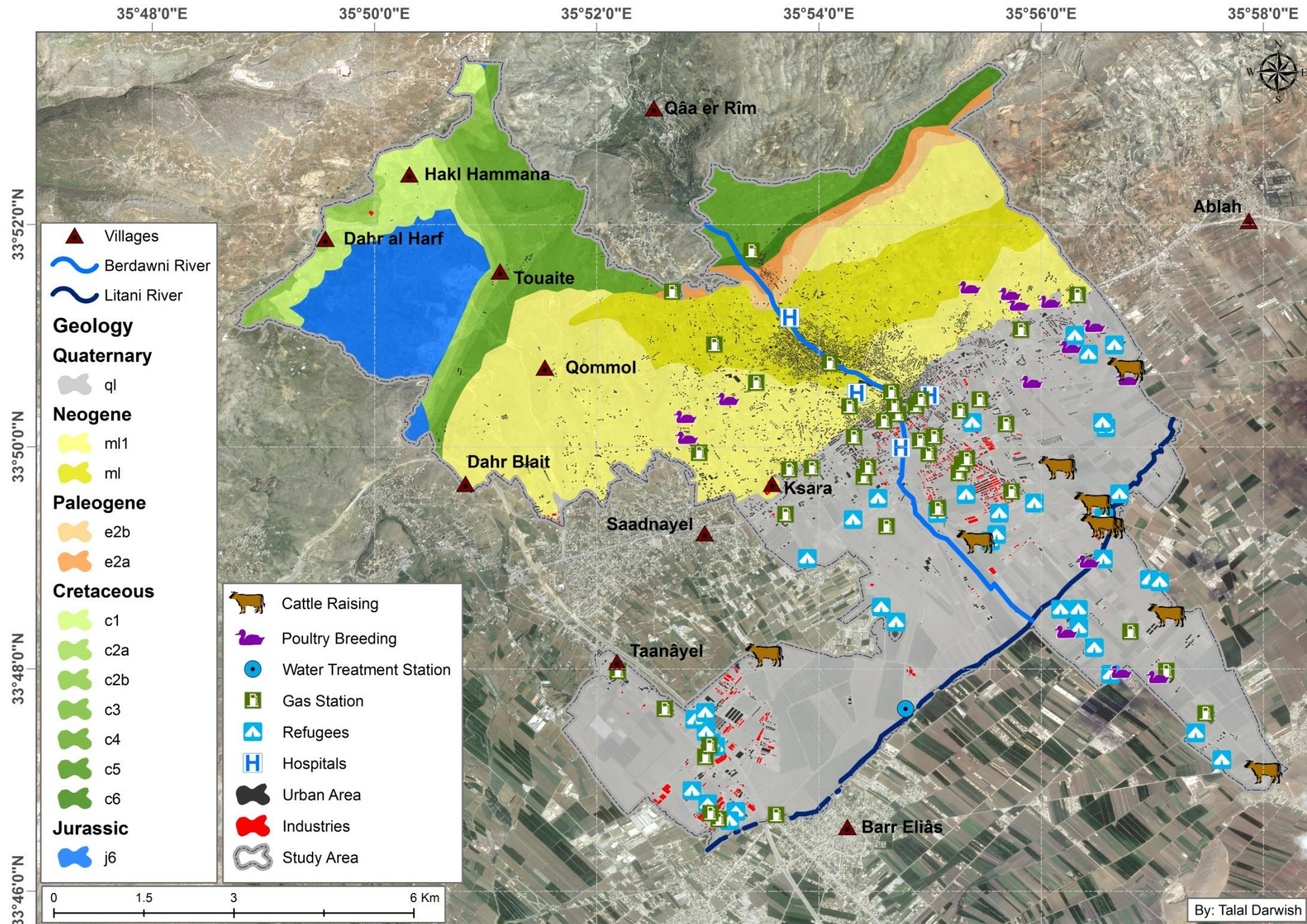
Methodology

- Mapping (Geology, Soil, allocating assets, etc..)
- Field Minidisc Infiltrometer to measure the saturated hydraulic conductivity
- Measurement and Calculations
- Modeling (Flows, Floods, Landslides, etc...)

Mapping

Geology

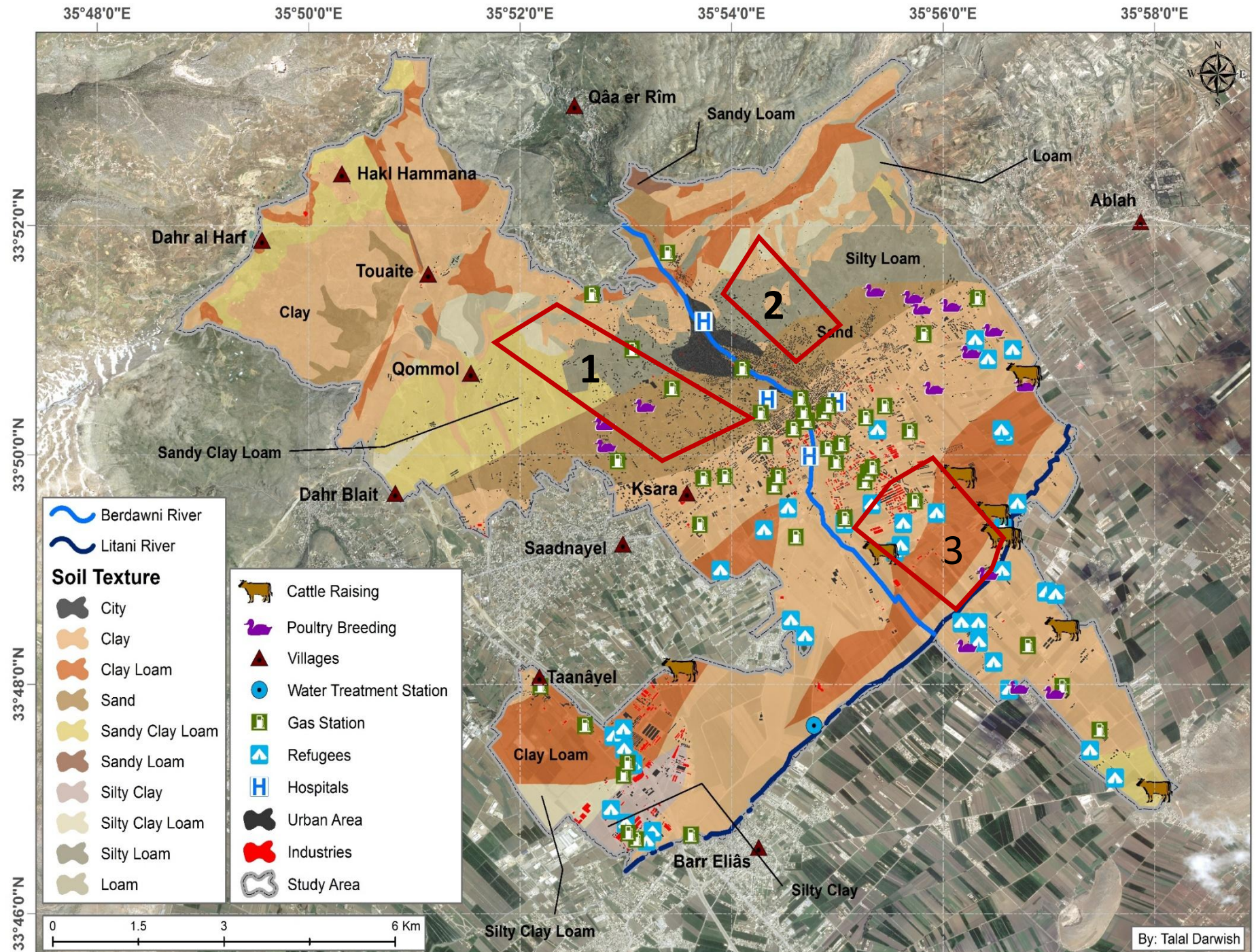
The Geology in the area of study are mainly Quaternary in the lower part and divided into Neogene, Paleogene and Cretaceous, Jurassic in the upper Part.



Mapping

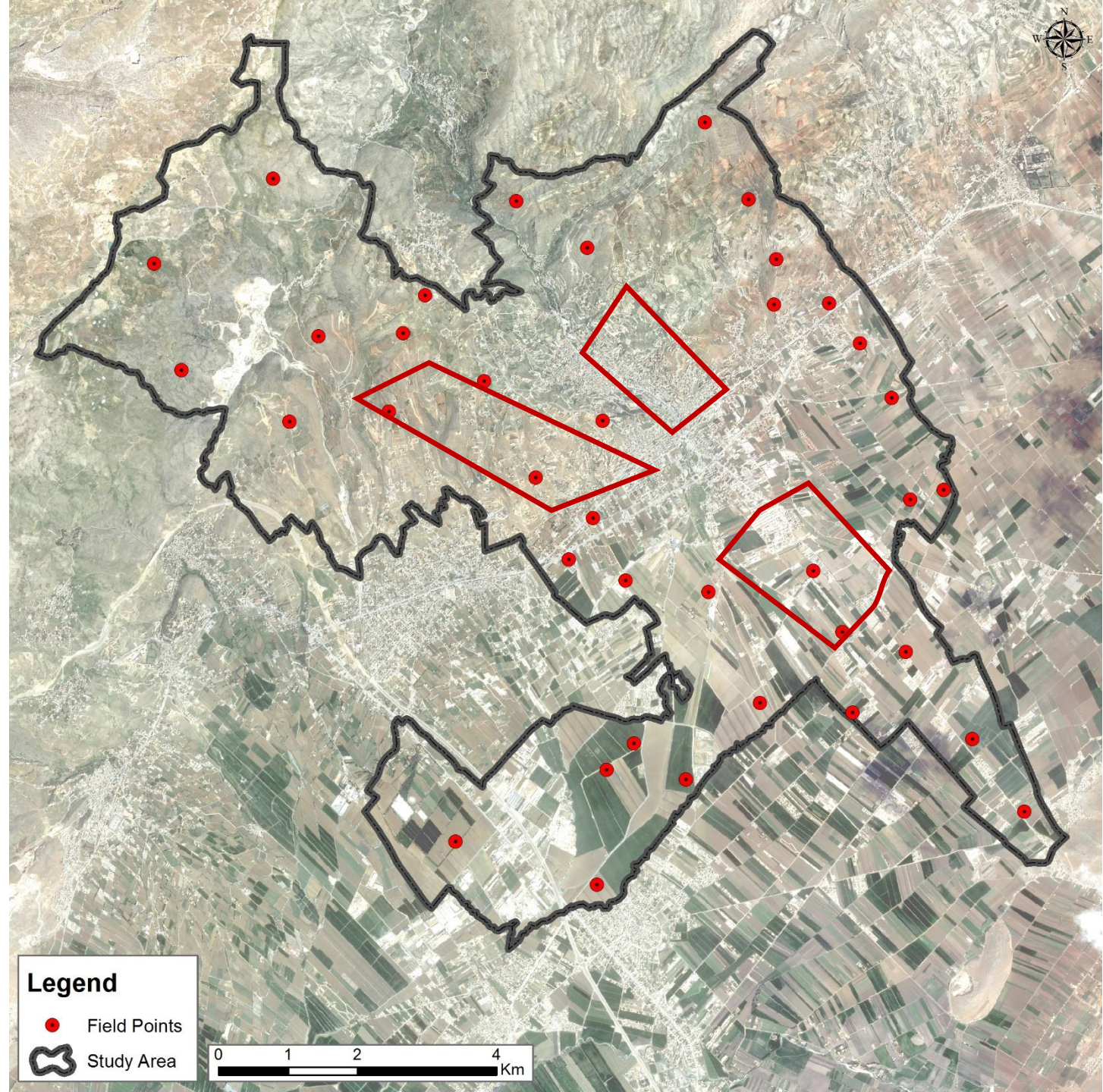
Soil & assets

Soil types with different textures from clay to loam, which can multiply the risks of pollutants transfer towards the groundwater.



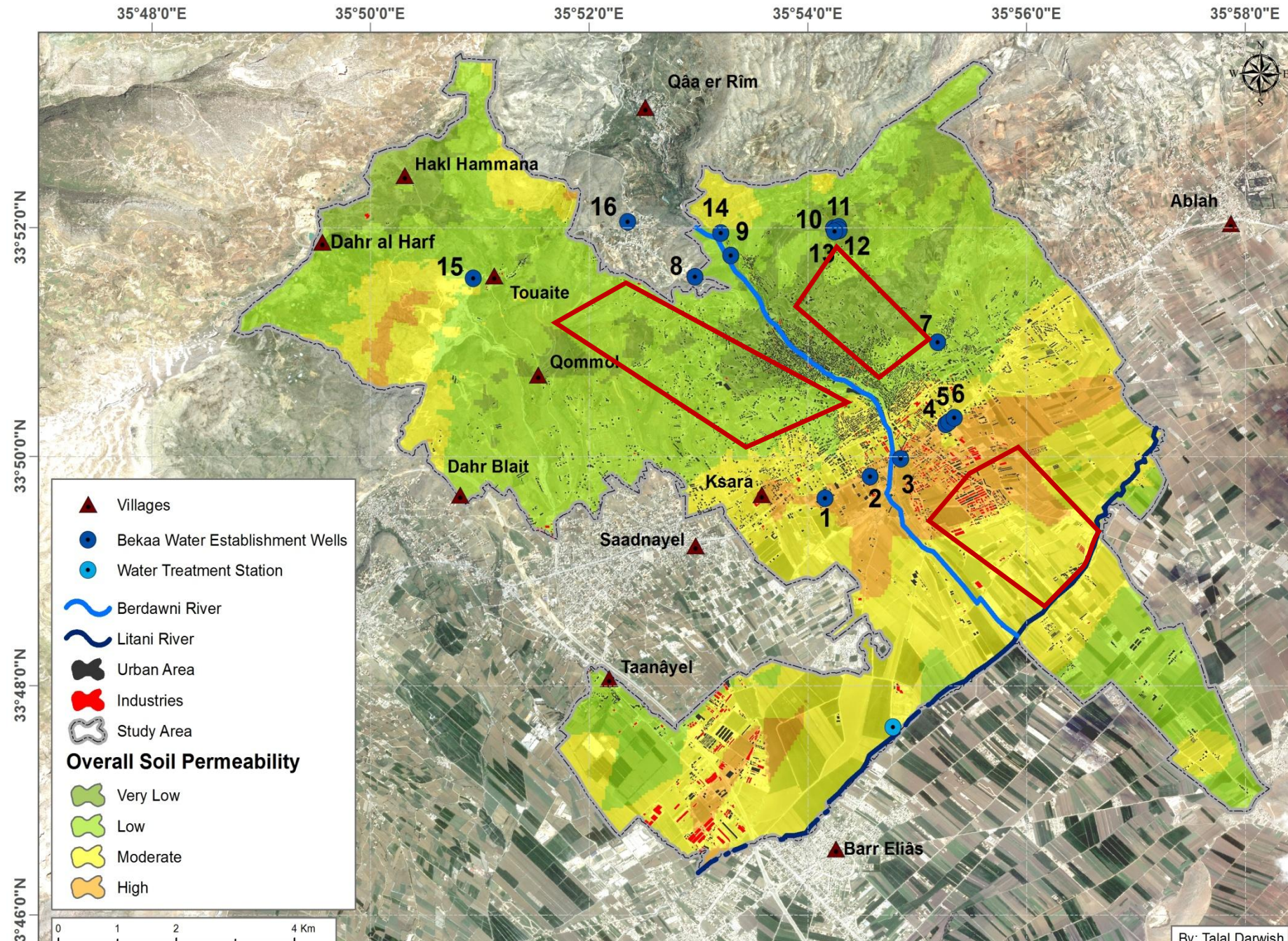
Field measurements

**Infiltrometer measurements
points**



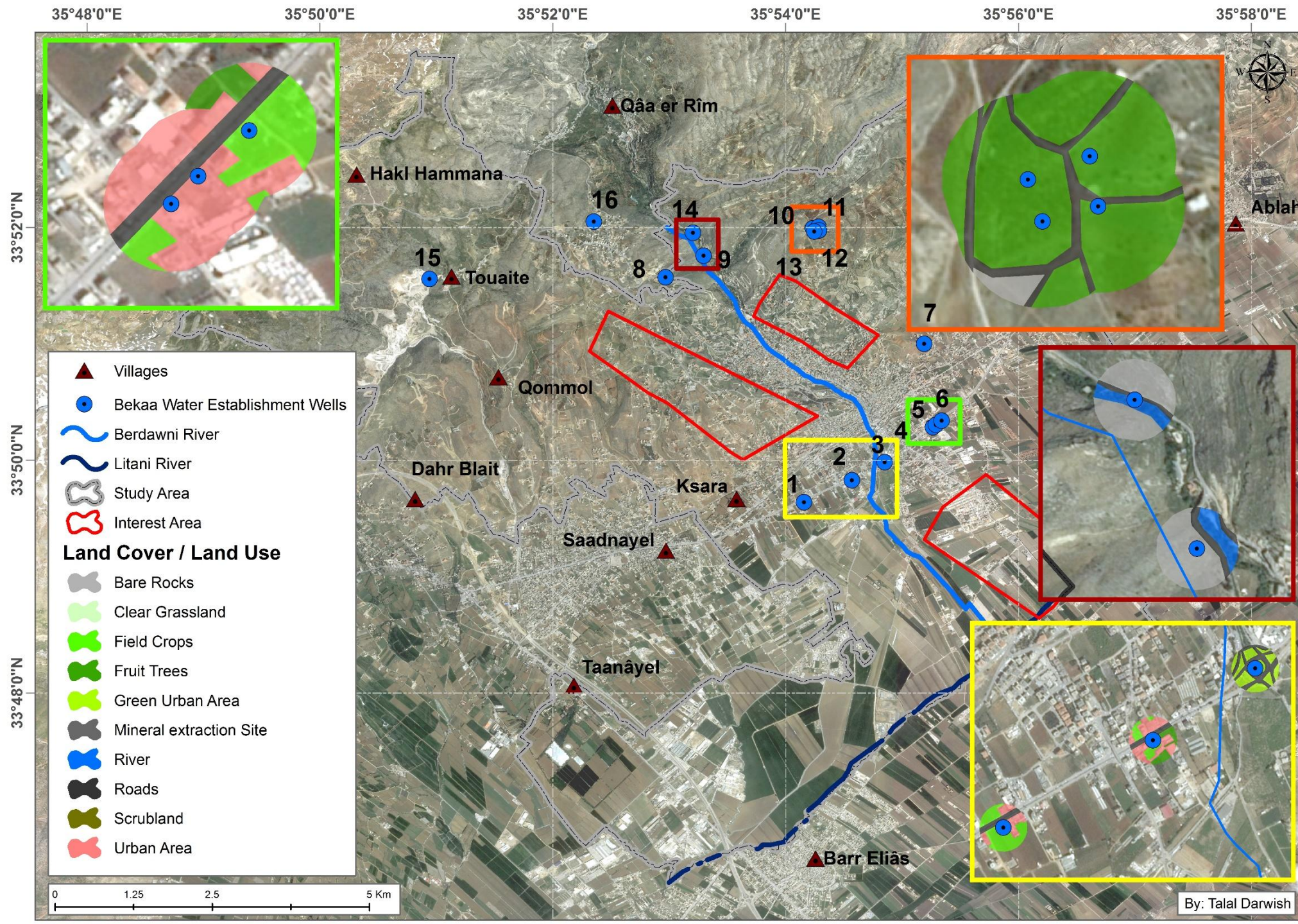
4. Overall soil Permeability map

- The central part of Zahle , especially near the center of the main city is low soil permeability. But the whole industrial zone is characterized by high soil permeability.
- 15 Wells for the Bekaa Water Establishment are distributed within the study area.



5. Mapping

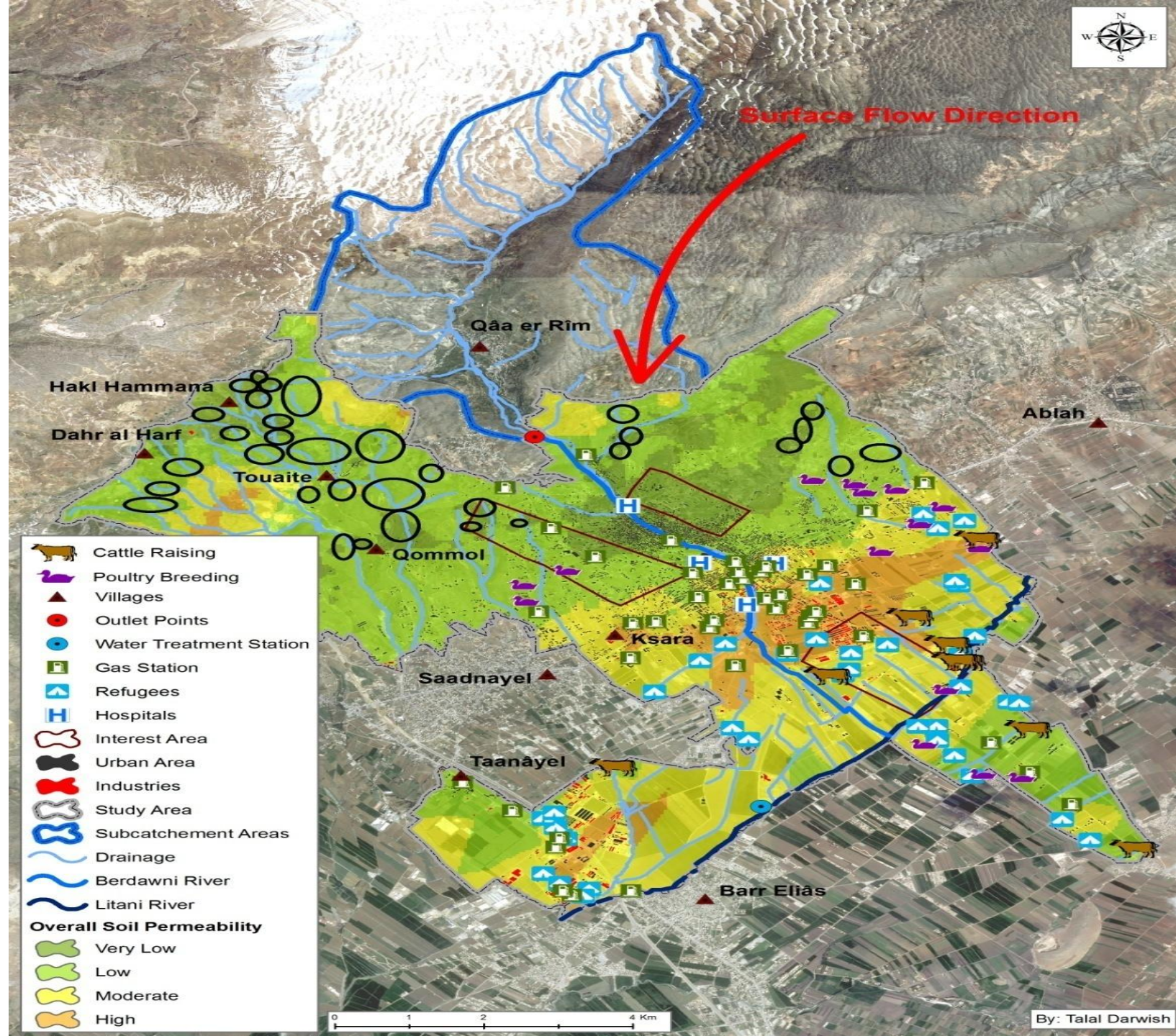
Land Use Cover & Municipality Wells



Surface Flow Direction and
Suitable water harvesting
structures.

Areas with very low and low
hydraulic conductivity
(dark green and green
colors) in the upper
watershed are suitable for
water storage for reuse in
irrigation.

Areas with moderate and
high transfer rate marked
in yellow and orange are
more suitable for
groundwater recharge.



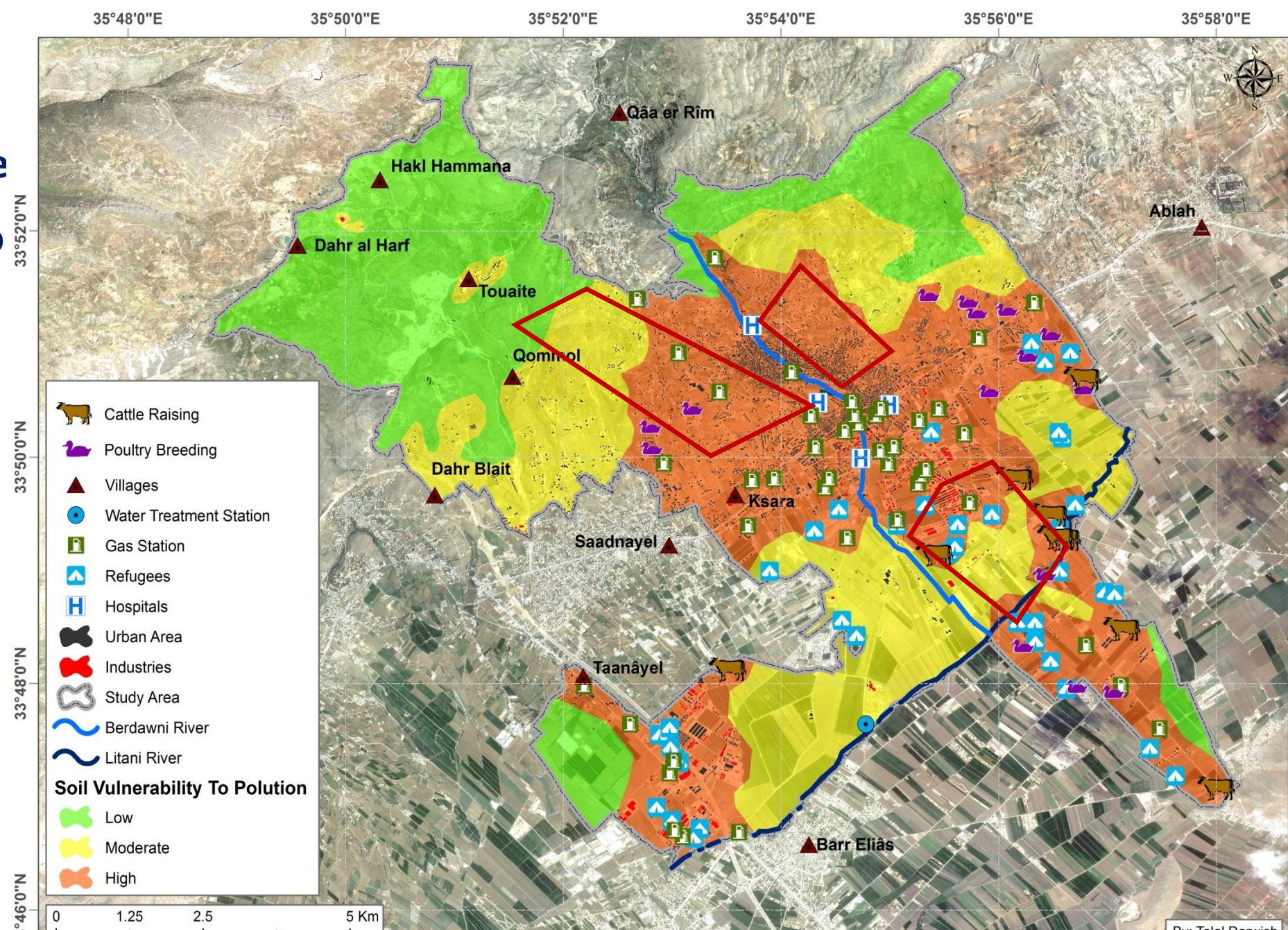
6. Analysis of soil exposure to contamination and transfer of pollution to the public wells of the Bekaa Water Establishment (BWE) in Zahle

- Focus area 1 and 2 are located on low and very low permeability. GW is well protected. Stability measures are needed from erosion and landslides.
- Focus area 3 is located in high and moderate permeability zone.
- The lower part of the area of study, notably Fayda witness shallow water table.
- Land use in the area must be controlled to:
 - Avoid urban and industrial expansion and
 - Reduce the input of chemicals and prevent the soil-groundwater from contamination with nitrates, heavy metals and pesticides.
- This can be done through the shift to integrated agricultural production with gradual introduction of organic farming.

7. Soil Vulnerability to Pollution

A significant area of Zahle City has high and moderate vulnerability to pollution with surface flow from natural (soil erosion, landslide) and manmade hazards.

The central part of the area of study is the zone the most exposed and most vulnerable to the input of contaminants from hospitals, sewage water, gas stations, refugees and animal husbandry.



8. Conclusion

1. Soil protection is a must in the upper part of focus zone 1 and 2, most suitable for water harvesting. These two zones must be however protected from soil erosion and landslides (zone 1) and agricultural activities with potential use of pesticides (zone 2).
2. Focus zone 3 is very exposed to pressure from all human and natural factors. This zone is medium and highly permeable especially sensitive to industrial effluents and to the potential transfer, in relatively short time, of soluble pollutants to groundwater.
3. Public wells 1 and 2 are subject to urban influence while well 3 is close to highway. These three wells are the most affected by human activities. Wells 4, 5 and 6 are mostly affected by industrial activities. Wells 10-13 are located near agricultural areas (pesticides and fertilizers). Wells 9 and 14 are relatively the most protected.