

Landslide Hazard Assessment Methodology

Institute of Geology and Seismology of
Republic of Moldova



Istanbul , 13 March 2014

Landslide mapping

1. Geomorphologic analysis of actual topographic (ortophoto) map:
 - Slope inclination before 3 degree (5 %)
 - Slope inclination in the interval 3 – 6 degree (5 – 10 %)
 - Slope inclination more 6 degree (10 %).
2. Study of geology and lithology condition of upper part of geological section (up to baseline of erosion):
 - Quaternary continental rocks: loess loam, sandy loam, dusty sand;
 - Alluvial formation of river terraces: loam, sandy loam, sands with different granulometric composition;
 - Neogen rocks: clay, sandy clay, sands with different granulometric composition, limestone.

Landslide mapping

1. The scale of mapping:

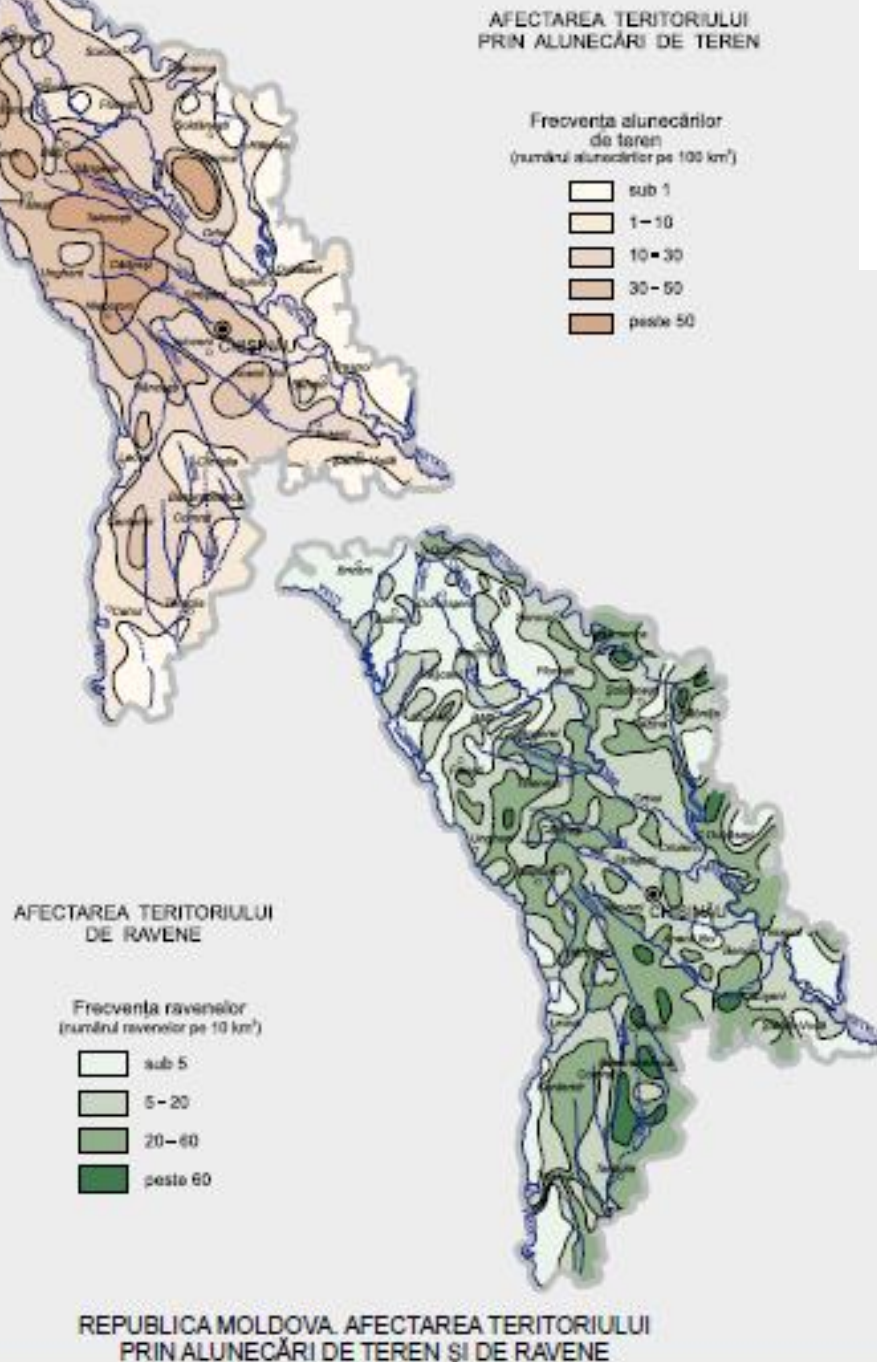
- Regional 1:500 000 – 1:100 000;
- Medium or feasibility study scale 1:50 000 – 1:10 000;
- Local or project design study scale 1:10 000 – 1:2 000.

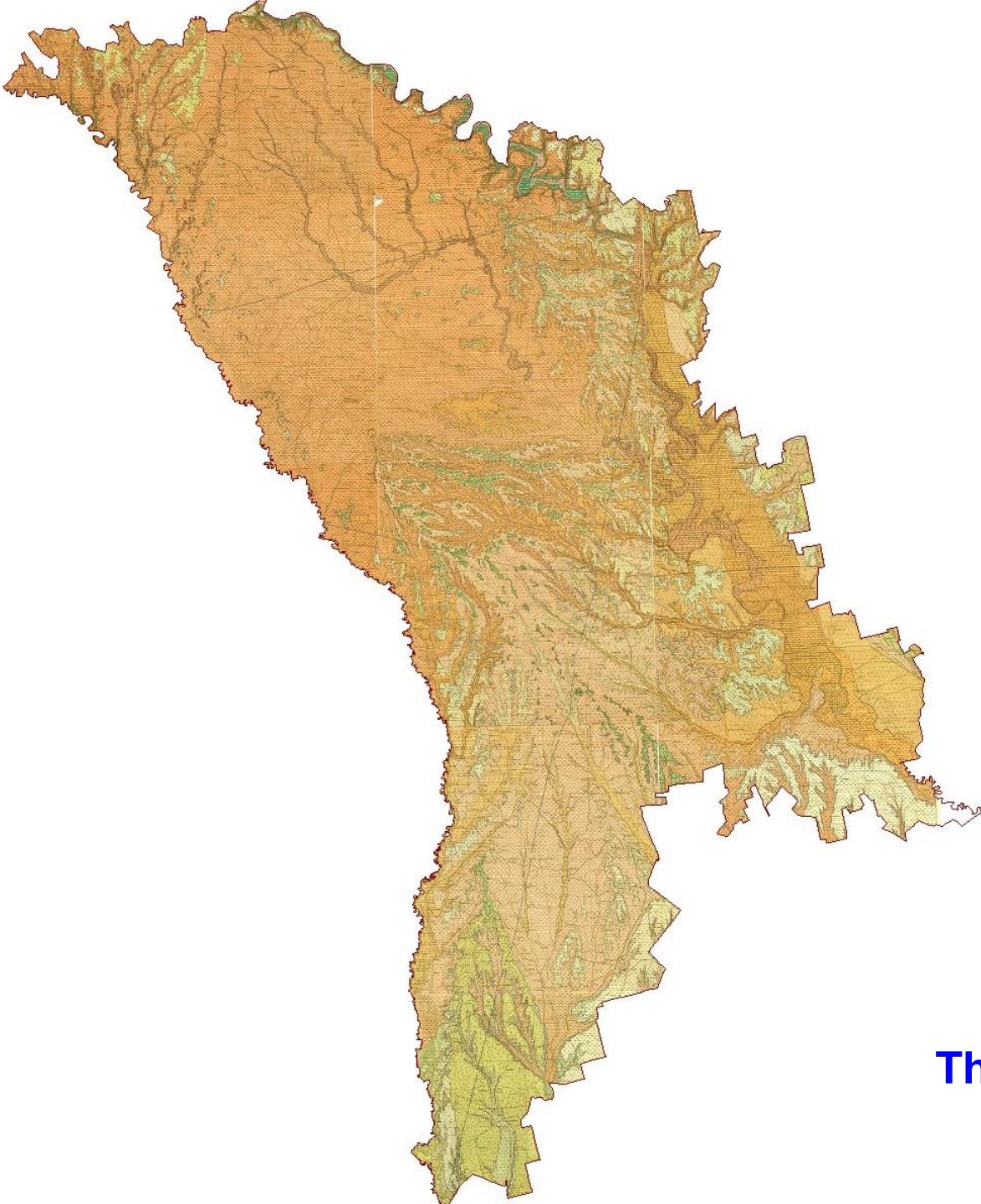
Regional scale mapping is used for general territory investigation and evaluation of geological condition.

Medium scale mapping is used for the regional feasibility study for special projects (as usual for melioration purposes in Republic Moldova, which was made for all territory).

Local scale mapping is used for the elaboration of General Plan of Development of localities (1:10000, 1:5000) and project design of concrete construction object (1:2000 - 1:500).

The example or regional study of landslide and ravine density, scale 1:1500 000





Regional study

Geology map

scale 1:200000

**The base for landslide
regional study**

The map is in image format

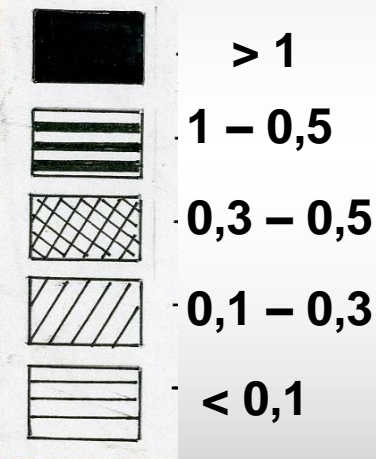
Regional study

Landslide map

scale 1:200000

(by L. Romanov and others)

The density of landslides per km²



The Methodology was – analysis of ortophoto images by non automatic mode

The map is in image format



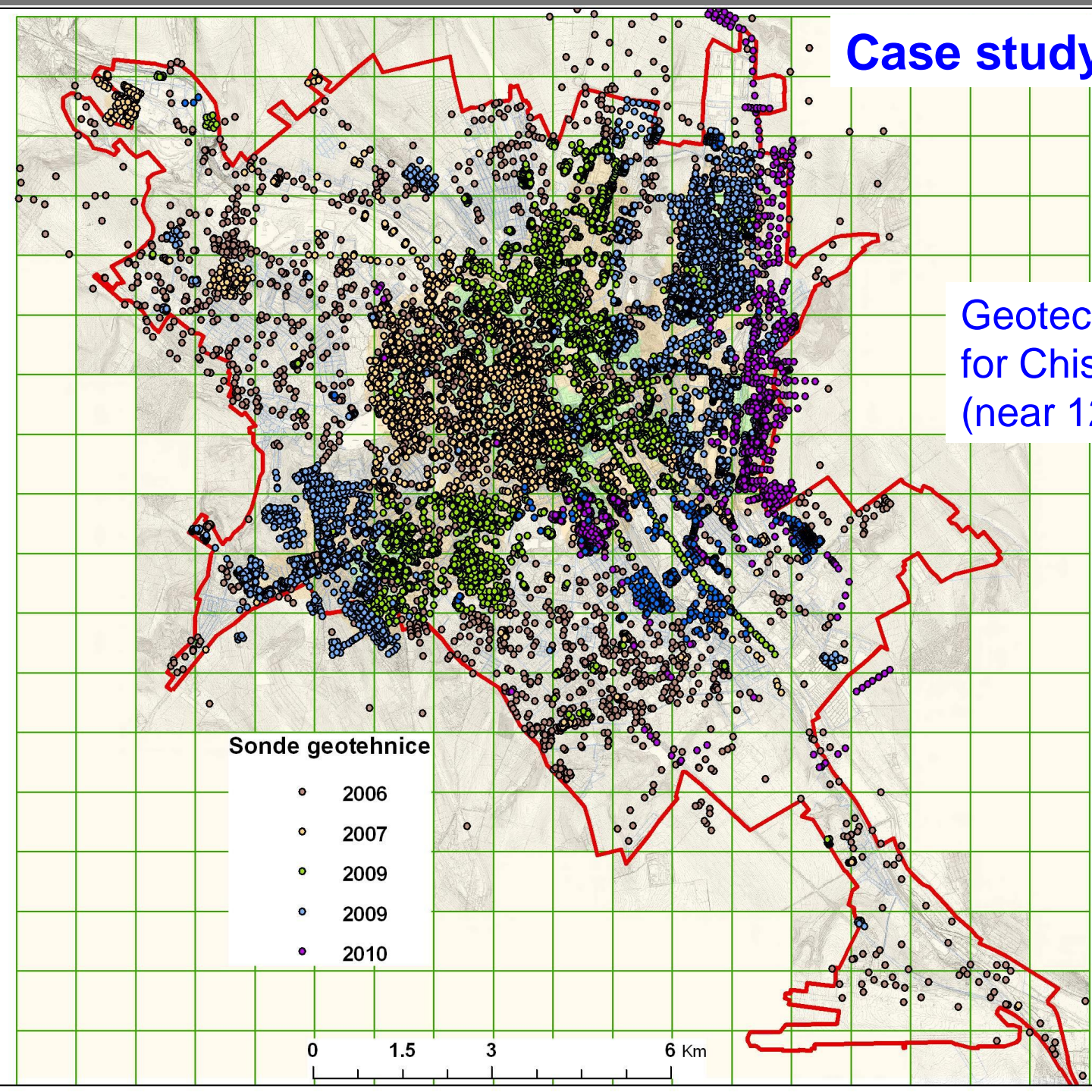
Case study for local scale

Geotechnical database
for Chisinau city
(near 12500 boreholes)

Sonde geotehnice

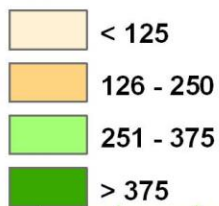
- 2006
- 2007
- 2009
- 2009
- 2010

0 1.5 3 6 Km



The density of
geotechnical boreholes
for geotechnical study
of Chisinau city

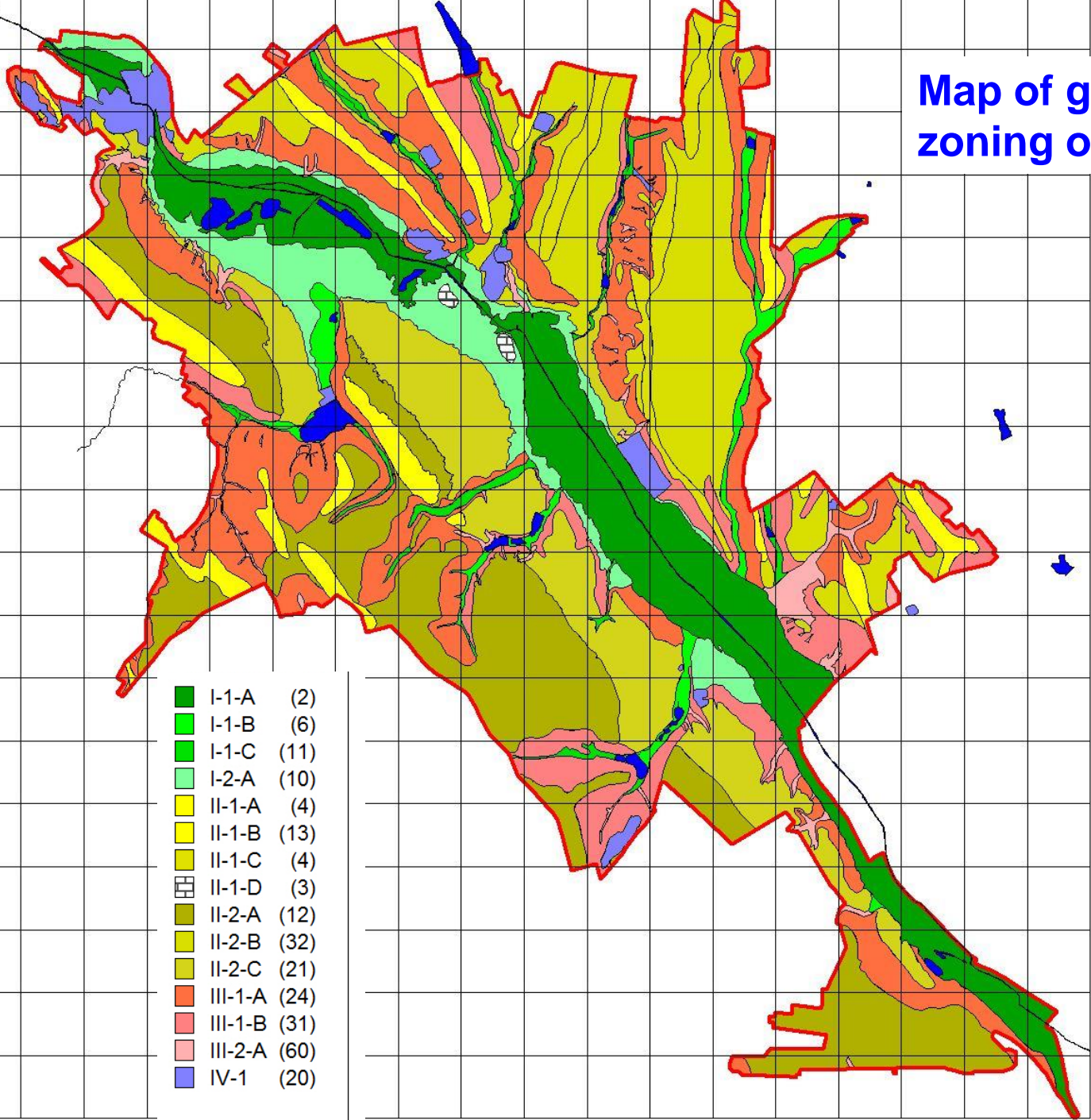
Densitatea sondei



0 1.5 3 6 Km

Map of geotechnical zoning of Chisinau city

Scale 1:10000

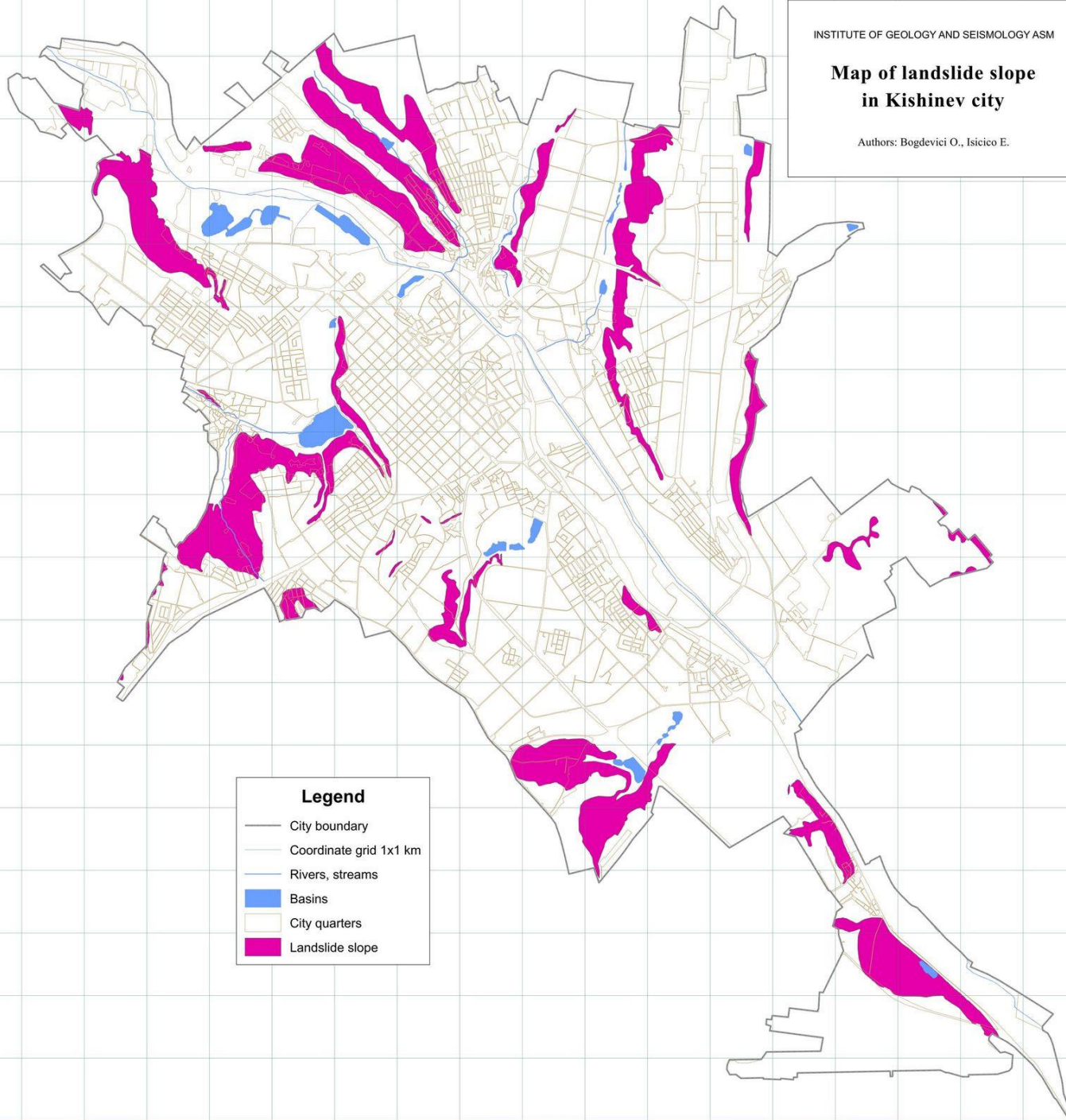
- 
- The map displays the geotechnical zoning of Chisinau city, with various colored regions representing different geological and geotechnical conditions. The city's boundary is outlined in red. The legend in the bottom-left corner provides a key for the colored zones, each associated with a specific code and a number in parentheses. The zones are distributed across the city, with some areas showing more complex patterns, such as the hatched area for II-1-D. The map is overlaid with a grid for reference.
- | | |
|---------|------|
| I-1-A | (2) |
| I-1-B | (6) |
| I-1-C | (11) |
| I-2-A | (10) |
| II-1-A | (4) |
| II-1-B | (13) |
| II-1-C | (4) |
| II-1-D | (3) |
| II-2-A | (12) |
| II-2-B | (32) |
| II-2-C | (21) |
| III-1-A | (24) |
| III-1-B | (31) |
| III-2-A | (60) |
| IV-1 | (20) |

Map of landslide slope in Kishinev city

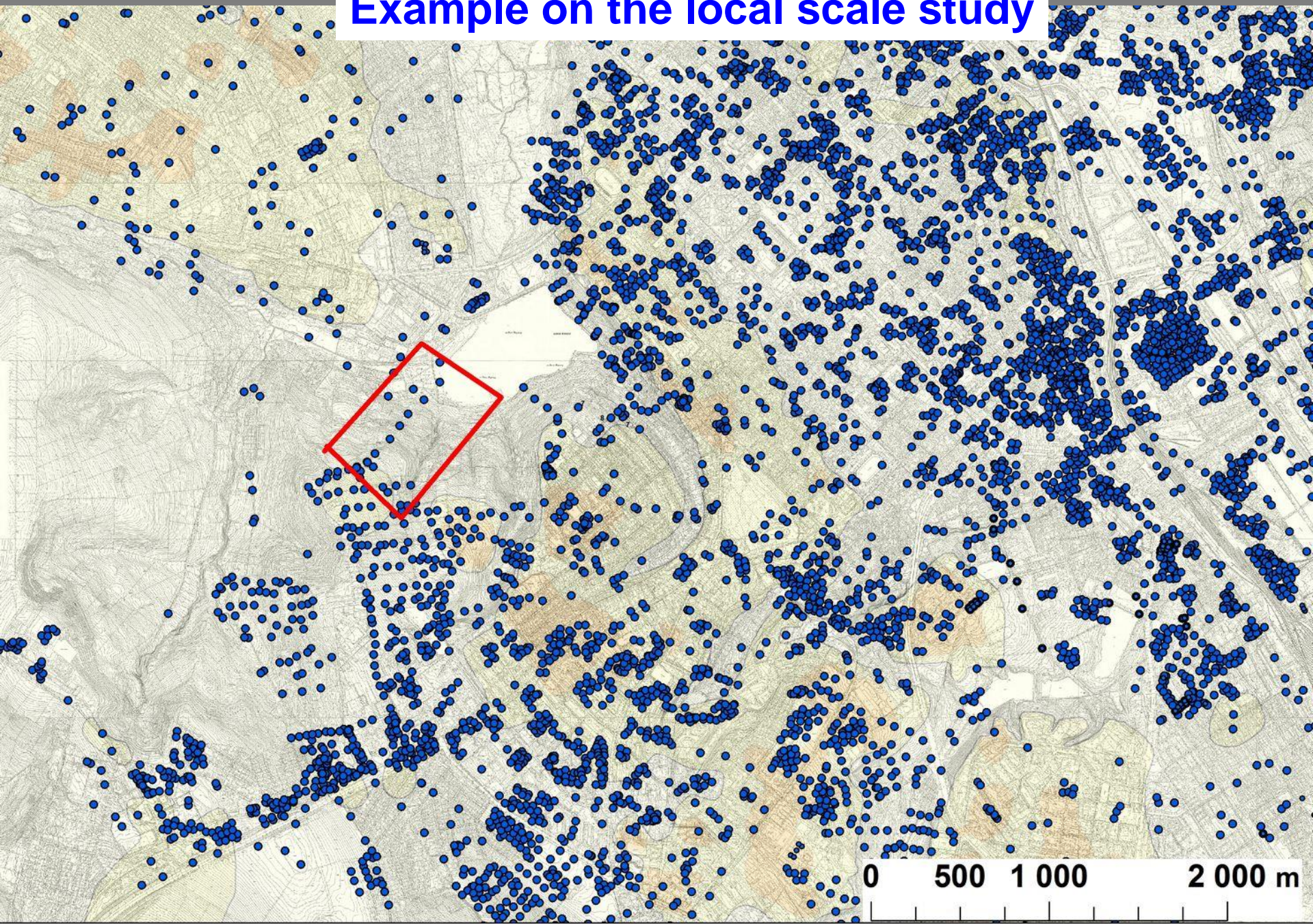
Authors: Bogdevici O., Isicico E.

Legend

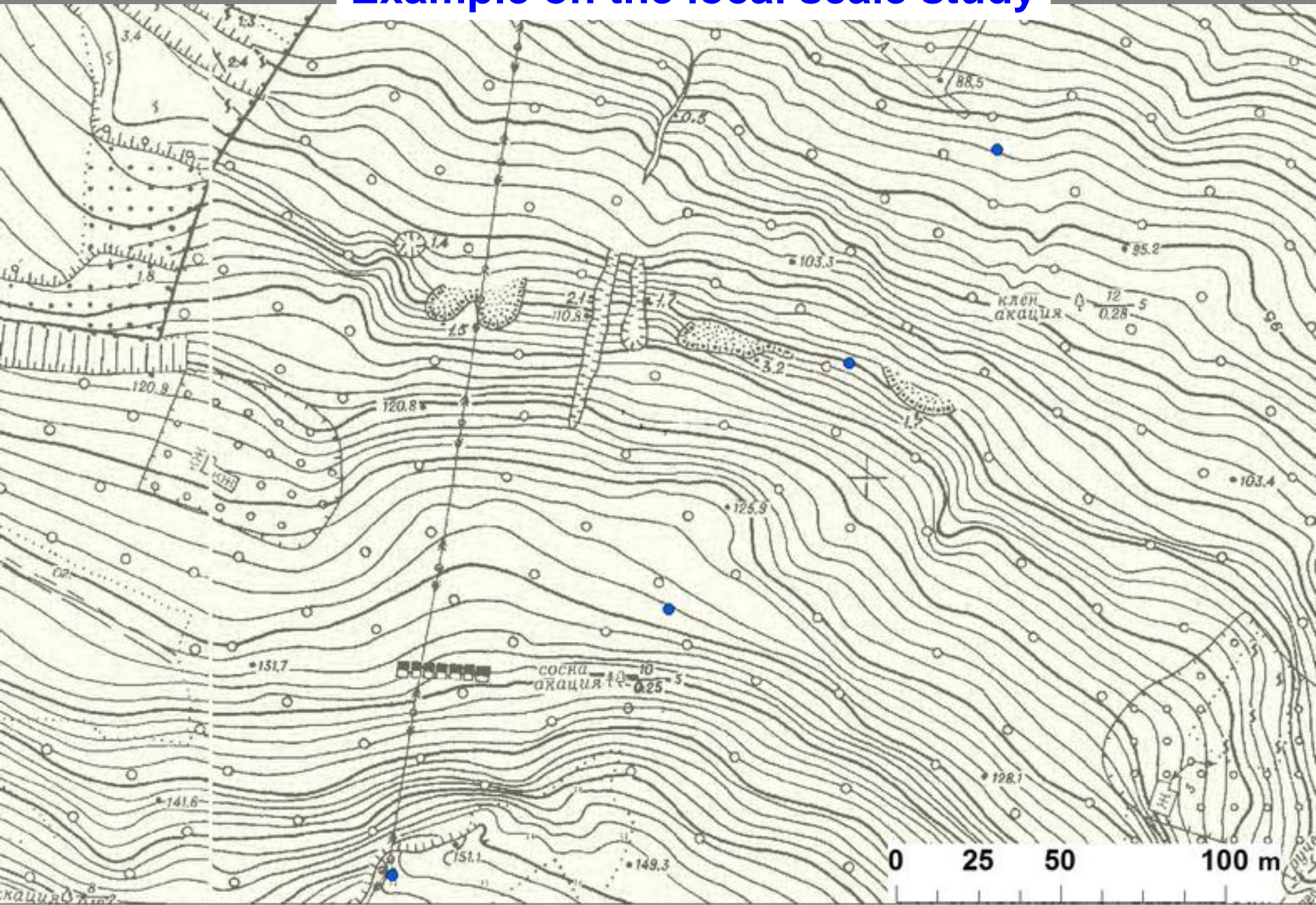
- City boundary
- Coordinate grid 1x1 km
- Rivers, streams
- Basins
- City quarters
- Landslide slope



Example on the local scale study



Example on the local scale study



The hotlink to geotechnical database

Geotech

En

Md

Ru

Cifrul original 10

Numarul raportului 1076

Sursa MoldGIINTIZ

Data forajului 12.04.1979

Geomorfologia Panta cu inclinatii de peste 6 grade

Categoria seismica a solului 0

Tipul tasarii 0

Nivelul actual al apei, m >15

Forajul 7624


Coordonate: X 9473

Y 29845

Cota absoluta, m 131.4

Adincimea, m 17

Nivelul apei, m



Coloana geologica, parametrii geotehnici

N	de la	pina la	Strat	Litologie	We	Wl	Wp	Ip	I	Ro	Ro_sk	Ro_w	Ro_s	n	e	G	Sig_nat	Sig_3	Pt	Wn	Hn	Pn	Remarca
1	0	1.2	Q4	sol artificial																			
2	1.2	2	Q4	sol																			
3	2	9	Q3-4	argila nisipioasa																			
4	9	17	Q3-4	argila nisipioasa																			

Valoarea normativa pentru sonde: 7620-7626

Additional

Desemnare

Iesire

Normative si calculate proprietatilor fisico-mecanica a straturilor

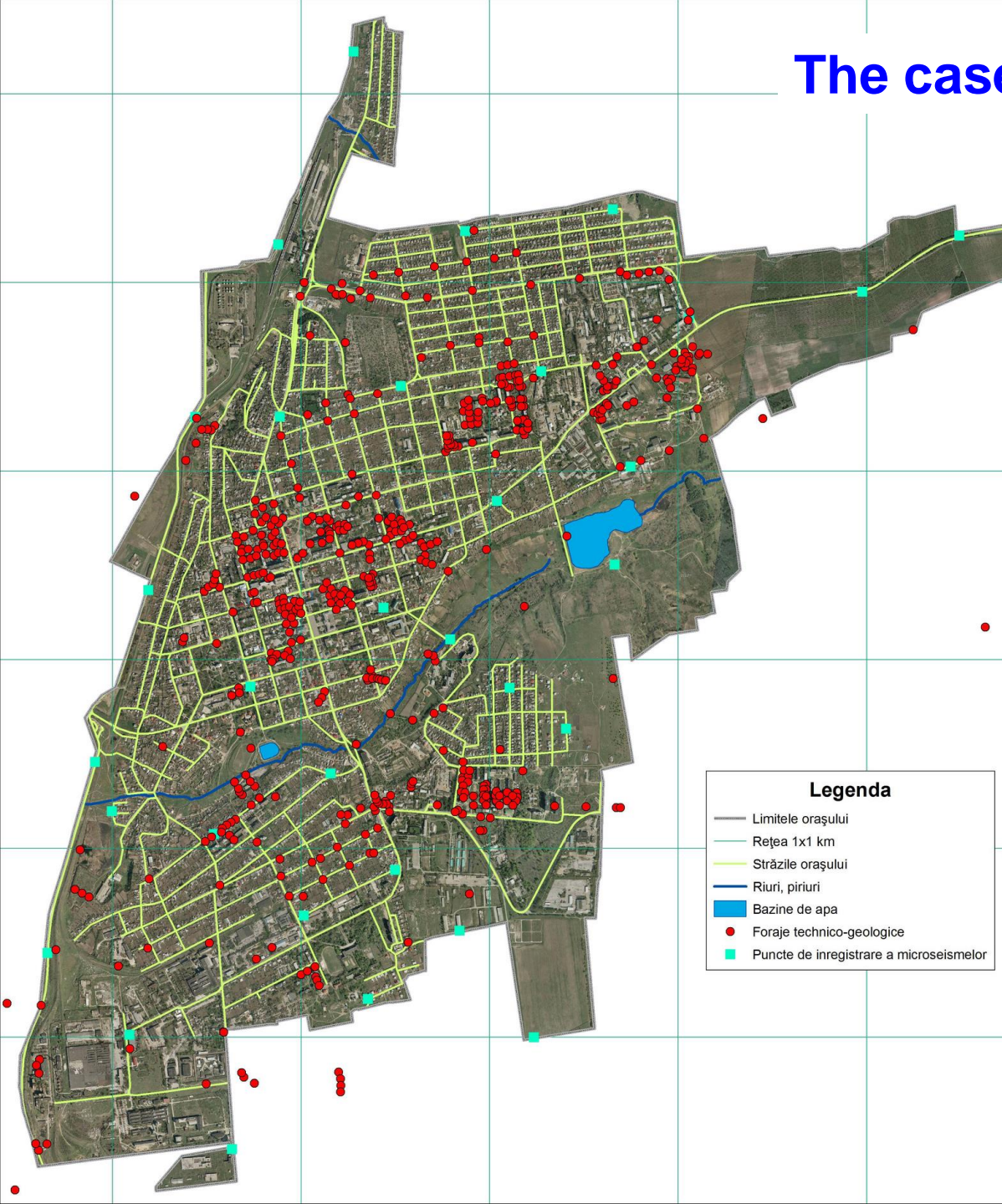
N	de la	pina la	Strat	Litologie	We	Ip	I	Ro	Ro_sk	Ro_w	Ro_s	n	e	G	E	Ev	Evu	C	Cw	Cwu	F	Fw	Fwu	R2	R2w	R2wu	C2	C2w
1	0	1.2	Q4	sol artificial																								
2	1.2	2	Q4	sol																								
3	2	9	Q3-4	argila nisipioasa	0.18	0.14	<0	1.88	1.59	2	2.69	40.9	0.692	0.7	20	15	22	28	23	32	24	19	23	1.86	1.98	2.03	27	22
4	9	17	Q3-4	argila nisipioasa	0.19	0.16	0	1.91	1.61	2.01	2.69	40.16	0.671	0.76	21	16	24	29	24	33	24	19	23	1.89	1.99	2.02	28	23

Desemnare

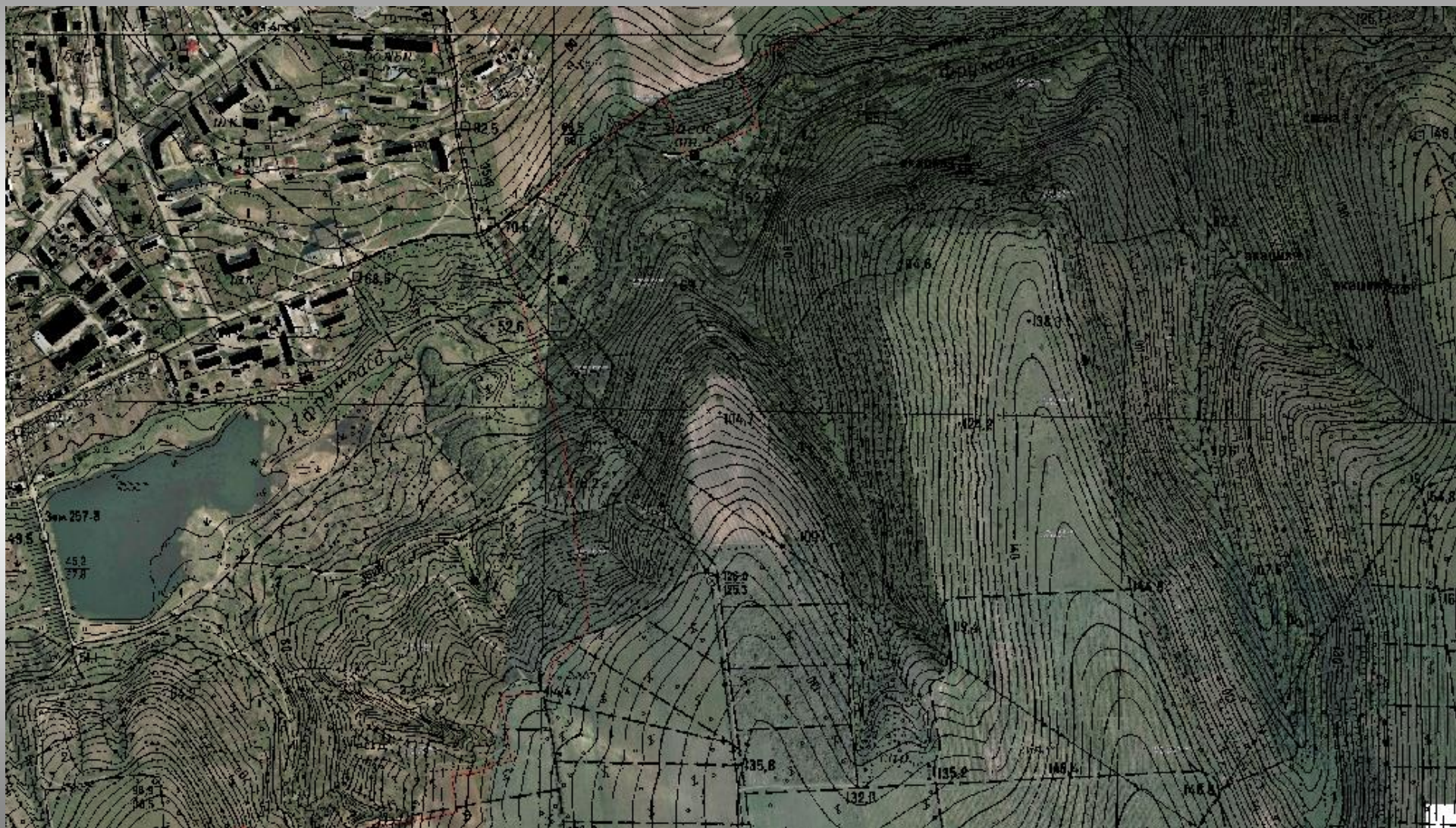
The case study of Cahul town

1. Geomorphologic analysis of actual topographic (ortophoto) map:

2. Study of geology and lithology condition of upper part of geological section.



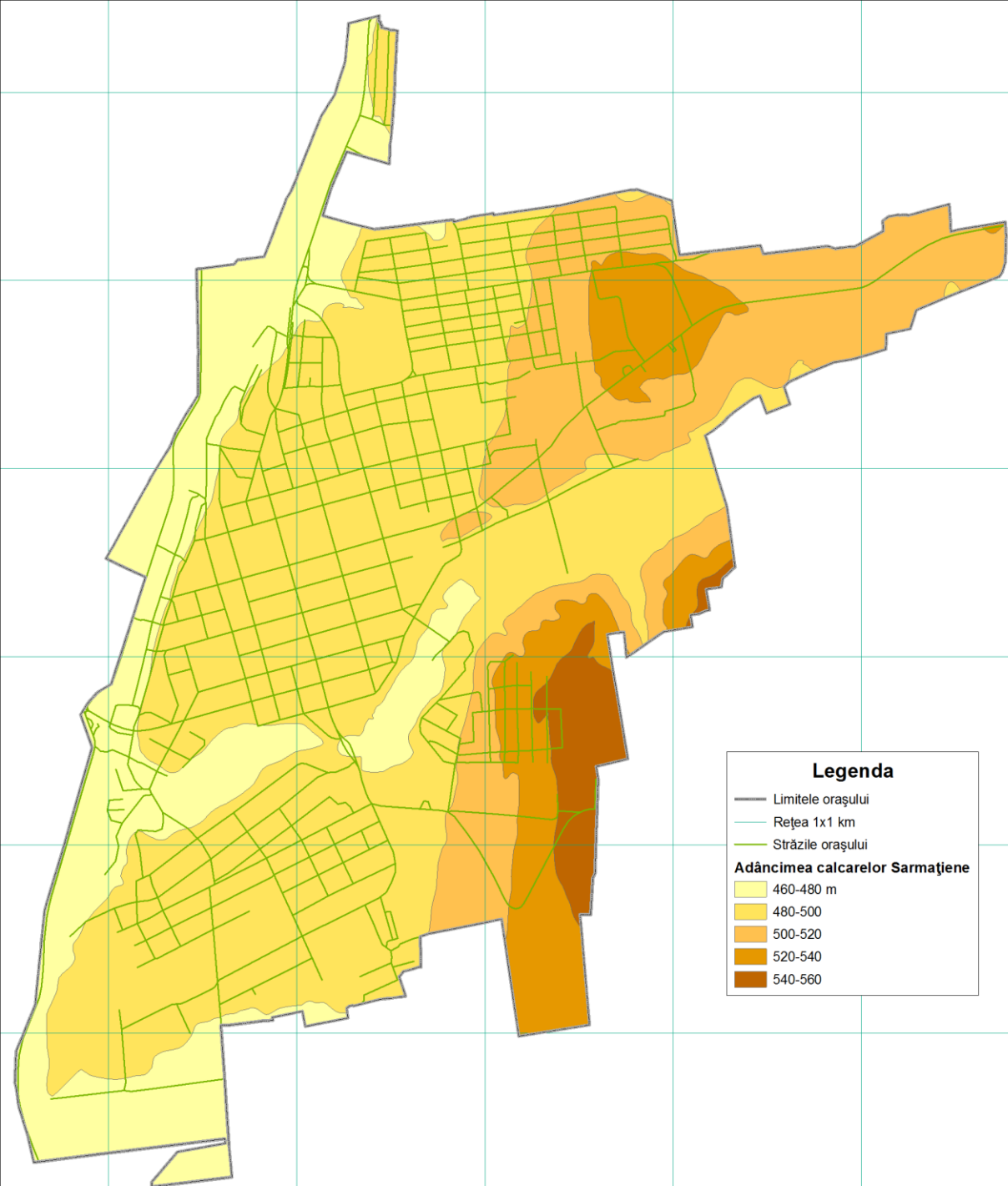
Geomorphology analysis



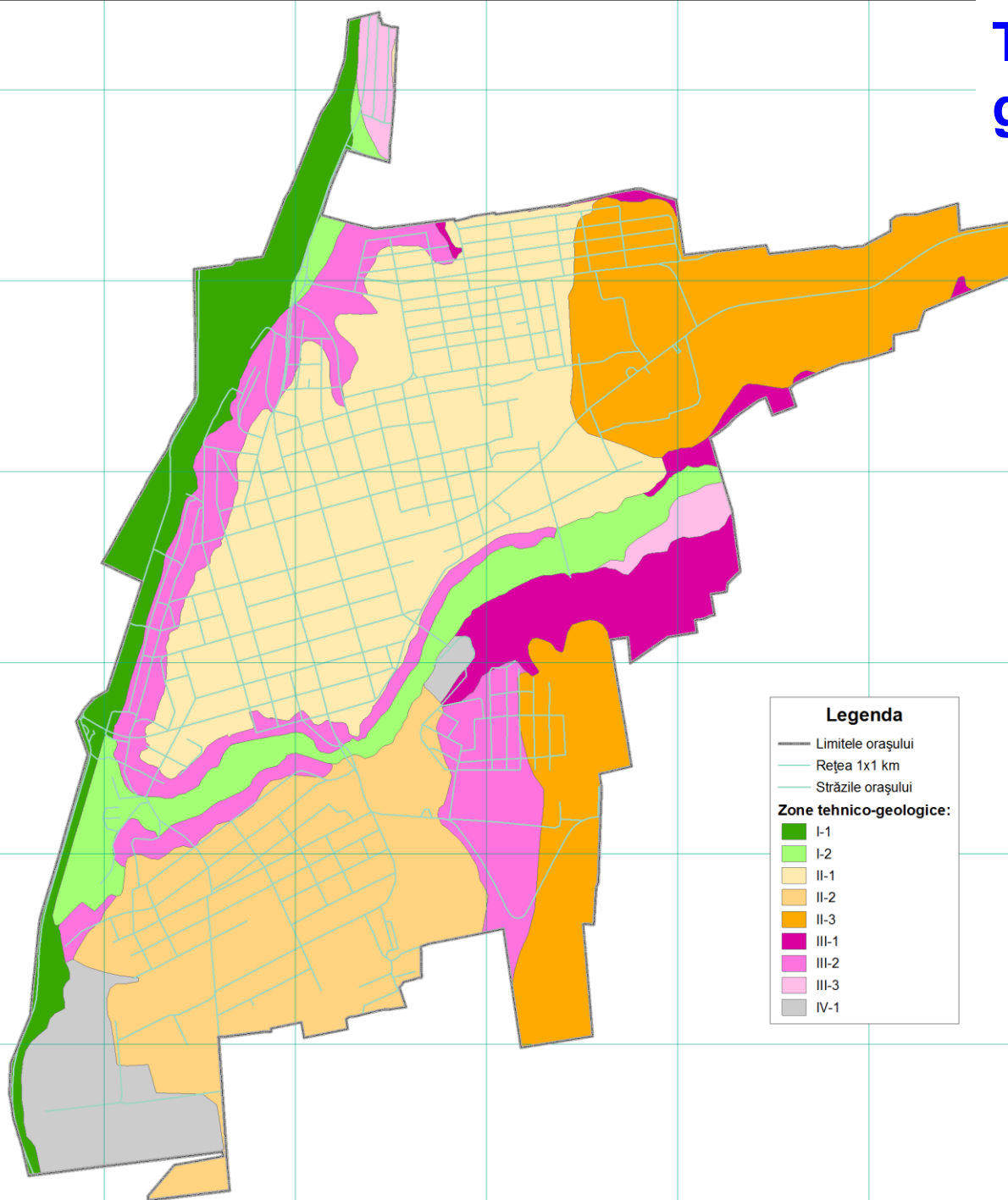
The modelling of geotechnical condition fields: desktop and field trial



The depth to limestone formation



The map of geotechnical zoning



Conclusion

- **The landslide inventory is needed for all territory of Republic of Moldova for regional geological risk assessment.**
- **The principal geological information is actually in analog format and need to be digitized**
- **The utilization of modern GIS approach is needed for the regional geological hazard and risk assessment.**