GIS & RS CONSULTING CENTER
10 Bulachauri Street
0160 Tbilisi, Georgia
Tel.: +995 322 382542
Fax: +995 322 381948
E-mail: office@geographic.ge
www.geographic.ge

To: The Swiss Cooperation Office (SCO)
Address: 9 Radiani Street, 0179 Tbilisi, Georgia

Schweizerische Eidgenossenschaft
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Confederazione Svizzera
Confederaziun svizra

SCO DRR PROJE CT IN GEORGIA

CONSOLIDATION OF THE HAZARD MAPPING METHODOLOGY AND ASSESSMENT OF THE LEGAL FRAMEWORK FOR ITS APPLICATION

HAZMAP REPORT

From: GIS and RS Consulting Center GeoGraphic LLC
Address: 10 Bulachauri Street, 0160 Tbilisi, Georgia
Tel.: +995322382542
Fax: +995322381948
E-mail: office@geographic.ge
www.geographic.ge

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Abbreviations

1D/2D/3D	1/2/3-Dimentional
ArcGIS	Proprietary GIS software by ESRI
ArcInfo	Proprietary GIS software by ESRI
b&w	Black and white colour pallette
CD	Compact Disk
CENN	NGO Caucasus Environmental NGO Network
CMF	Caucasus Mountain Forum
CMYK	Cyan, Magenta, Yellow and Key (black) colour model
C-SDI	Caucasus SDI
DEM	Digital Elevation Model
DRR	Disaster Risk Reduction
DXF	Drawing Interchange Format by AutoCAD
EC	European Community
ECMWF	The European Centre for Medium-Range Weather Forecasts
EEA	European Environmental Agency
EHQ	German abbreviation meaning 'extremely high flood' event
EIONET	European Environment Information and Observation Network
EMA	Emergency Management Agency, MIA of Georgia
ESRI	Environmental Systems Research Institute
EU	European Union
EU-GE AA	EU-Georgia Association Agreement
EUSC	European Union Satellite Centre
GEO	Group on Earth Observations
GEOBIA	Geographic Object-Based Image Analysis
GeoGraphic	GIS and RS Consulting Center 'GeoGraphic'
GEOSS	Global Earth observation System of Systems
GIS	Geographic Information System
HazMap	Hazard Mapping
INSPIRE	European Directive 2007/2/EC establishing an INfrastructure for SPatial InfoRrmation in the EC
InterLIS	Interchange of Land Information System (Swiss software package)
JRC	EU’s Joint Research Centre
K&J	Kordzakhia Jgenti Law Firm
LEPL	Legal Entity of Public Law

LLC	Limited Liability Company
MIA	Ministry of Internal Affairs of Georgia
MoRDI	Ministry of Regional Development and Infrastructure of Georgia
MoE	Ministry of Environment and Natural Resources Protection of Georgia
MoESD	Ministry of Economy and sustainable Development of Georgia
MoF	Ministry of Finance of Georgia
MoJ	Ministry of Justice of Georgia
NAPR	National Agency of Public Registry, MoJ of Georgia
NEA	National Environmental Agency, MoE of Georgia
NSDI	National SDI
NSDI-GE	National SDI of Georgia
SAEFL	Swiss Agency for the Environment, Forests and Landscape
SCO	Swiss Cooperation Office in Georgia
SCOPES	Scientific co-operation between Eastern Europe and Switzerland
SDC	Swiss Agency for Development and Cooperation
SDI	Spatial Data Infrastructure
SEIS	EU’s Shared Environmental Information System
SFR	Swiss Frank
SIDA	Swedish International Development Cooperation Agency
SNAP	Sentinel Application Platform
StorMe	Events database in the natural disaster assessment system of Switzerland
TIF/TIFF	Tagged Image Format File
ToC	Table of Contents
ToR	Terms of Reference
UK	United Kingdom

SCO DRR PROJECT IN GEORGIA

CONSOLIDATION OF THE HAZARD MAPPING METHODOLOGY AND ASSESSMENT OF THE LEGAL FRAMEWORK FOR ITS APPLICATION

HAZMAP REPORT

Executive Summary

This report was produced by GeoGraphic (http://geographic.ge), under commission by the Swiss Cooperation Office (SCO) in Georgia, in cooperation with the National Environmental Agency (NEA), in order (i) to analyse and capitalise on the Swiss model hazard mapping methodology as applied on a pilot basis by NEA; and (ii) to review current legislation and provide recommendations on legal framework for advancing hazard mapping in Georgia.

The report starts with a comprehensive overview of the digital hazard mapping guidelines as applied in Switzerland (Luzern Canton case considered as a model to follow). Basic principles of hazard mapping concepts, such as intensity, return periods, map colour coding, integral/synoptic maps, protection structures and deficit mapping etc. are explained and summarised. In addition to references and internet sources, several critical documents are attached as appendixes to this report to make the description of the Swiss example as instructive as possible.

It is concluded with this chapter, that Swiss example is adequate to follow in Georgia, moreover that hazard mapping at the European level, as defined in the INSPIRE directive data specifications, is fully compatible with Swiss approaches, while this mountainous country shares many similarities with Georgia in terms of natural environment.

The next is presented the experience of NEA with pilot application of the Swiss hazard mapping methodology to 6 communities in Mestia Municipality of Georgia. In addition to endorsing significant advances achieved by NEA in this pilot exercise, some gaps were identified in availability of data and in the application of the methodologies.

Nevertheless, it is the key finding of this report, that despite data gaps and resultant deviations from methodology (such as lack of data for intensity and frequency components), NEA still managed to use its best expert judgement and generate properly scaled hazard maps in digital format, which allowed NEA and GeoGraphic to compile synoptic maps in GIS as well as in web-GIS formats, intimately following the Swiss data formats and schemas.

Two further important sections of this report are devoted to (i) analysis of current legal and institutional arrangements for hazard mapping in Georgia and (ii) recommendations on best pathways for transposition of Swiss and European hazard mapping guidelines into Georgian regulatory reality. Key finding is that implementation is possible without major efforts, such changes in the national legislation, rather with changes at the technical and regulatory level.

In the course of the study comprehensive consultations were held with NEA leadership and specialists, defining best pathways and validating with NEA management proposed technical, legal and institutional prerequisites for the advancement in a comprehensive manner the legal and institutional arrangements for hazard mapping at the national level. Additional input was provided by NEA specialists with specific emphasis on flooding hazard, which can be considered as a standalone issue, but also demonstrating NEA competence with the hazard mapping instrument.

Special session devoted to hazard mapping in Georgia was held at the first edition of the regional Caucasus Mountain Forum (November, 2016) to inform and engage the wider professional community. Conclusions drawn in consultation with the stakeholders are reflective not only of the legal and institutional, but also the technical considerations, so that proposed next steps are technically feasible, as well as appropriate and realistic in terms of proposed arrangements for the future. The reader is therefore directed to The Way Forward section, where all key findings are summarised and the next practical implementations steps are suggested.

HAZMAP REPORT

This report was produced by GeoGraphic, Georgia (http://geographic.ge) closely following the provisions of the task Terms of Reference (ToR) issued by Swiss Cooperation Office (SCO) in Georgia as well as the methodology proposed by GeoGraphic in line with the ToR requirements and as confirmed in the inception report, main aim of which was to formulate the factual work plan for the implementation of project activities. Details contained in the ToR methodology (project background, objectives, deliverables, proposed methodology and team) are not repeated hereby to keep the report compact, but this report should be read with the understanding of the contents of mentioned documents (ToR is provided as the last Appendix VII to this report).

1. Objectives

Objectives as formulated in the study ToR and confirmed in the methodology deliverable are reproduced below:

1. From the technical side the objective is to consolidate the Hazard Mapping Methodology developed by the NEA specialists, to discover existing gaps and define improvement needs in order to allow a cohesive approach between the geology and hydrology thematic areas.
2. From the legal perspective the goal is to undertake a review of current (and draft if applicable) legislation related to hazard mapping. Provide recommendations on general procedure for setting up a comprehensive system and legal framework for the application of Hazard Mapping at all governmental levels.

2. Approach

Methodology proposed to address requested task order was based on the following considerations:

- Swiss statutory model was selected for accommodation to Georgian conditions (although comparative example of INSPIRE hazard mapping data specification was reviewed as a complementary experience as well). This can be justified by the long-term experience of Switzerland in the field and similarity of the nature and the range of issues faced by both countries, as well as obviously the history of cooperation in this field. The document therefore contains comprehensive but concise review based on Luzern Canton sample of Swiss regulations.

- Upon the review of Swiss experience, GeoGraphic is convinced that institutional model used in Switzerland, where employer are normally concerned local authorities, adviser in hazard assessment and in reviewing and defining the scope of work are agencies like NEA, while implementation of the hazard mapping usually rests with selected qualified and certified private companies, seems relevant for Georgia as well (with the exception that contract holder should preferably be NEA in Georgian case). GeoGraphic employed its existing in-house experience for technical analysis and involved experienced legal expertise to identify realistic suggestions in line with Swiss model, and issuing recommendations as far as possible compatibly with Georgia's institutional and regulatory system.

GeoGraphic familiarised to the extent possible with tools and instruments applied in Switzerland for hazard mapping and applied following approaches in the course of the study:

- ArcGIS environment was used to collate all existing datasets of NEA developed so far and to complement them with the in-house datasets of GeoGraphic, to demonstrate the importance of the quality use of the GIS platform for the integration of data available to NEA as well as required for hazard mapping into clear and easy to use decision-making maps for local authorities (Mestia in this case). It is acknowledged, that some Swiss tools might be complicated to use, still some demonstrated results show that Swiss approach to data storage, symbolisation and visualisation is realistically possible and can be implemented in Georgia. The report is accompanied by datasets compiled in this manner utilising hazard data provided by NEA.

- In this respect, GIS, web-GIS and SDI toolsets were used to integrate certain types of hazard mapping layers and to derive integral products in a way similar to Swiss standards. Some of these steps are value added in terms of further integration of NEA collated and generated data.

- Range of recommendations (and practical demonstrations) provided are concerned with on-going NSDI process, as well as INSPIRE Directive compatibility, and the ways how these can be integrated by NEA into the NSDI of Georgia.

- In its recommendations on integration within NSDI process, GeoGraphic was guided by INSPIRE technical guidelines (http://inspire.ec.europa.eu/data-specifications/2892), specifically INSPIRE Data Specification on Natural Risk Zones (Technical Guidelines 10.12.2013), which were reviewed and compactly explained below (see http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_NZ_v3.0.pdf).

- GeoGraphic in partnership with NEA committed themselves to disseminate produced recommendations and applications such as NSDI compatible product demonstrations at the Caucasus Mountain Forum 2016 (end of November), organised by leading Georgian and Swiss scientific community representatives and this is included in the program as a separate session (http://caucasus-mt.net/events/CMF). Another session on Caucasus-SDI would include demonstration of hazard mapping in open source web-mapping geonode for Caucasus. The forum is supported by Swiss program SCOPES under Sustainable Caucasus project.[1] Priorly preparatory presentation session was held at the Swiss Cooperation Office in Georgia on 15 November 2016.

Issues identified in hazard mapping methodology applications are reviewed below, listing some findings hereby:

- Certain components of the Swiss statutory methodology was possible to implement (3 hazard levels), based on NEA hazard rating methods, but certain important parts of the methodology were bypassed (9 matrix elements of intensities/recurrences). Still, based on hazard levels, Geographic generated integral/synoptic results.

- Hazard mapping exercise was conducted both for hydrology and for geohazards, but communication and joint work was somewhat insufficient between the disciplines. Nevertheless, it was demonstrated that integration of these fields is possible based on NEA data.

- Proper professional translations were required so that communication with international expertise is improved. It is hoped, that summaries provided in this report resolve this issue.

- It was analysed to what extent work was completed, what was done and what needs to be done.

- In certain cases methodology was applied indeed correctly, but some processing was not completed (e.g. identification of deficit areas in settlements under potential exposure). In this report NEA's data was used in combination with GeoGraphic's data on settlement spatial patterns to illustrate mapping outcomes in line with the Swiss methodological approaches.

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[1] Sustainable Caucasus project (launched in 2015, coordinated by University of Geneva) aims to strengthen cooperation among scientific institutions from Armenia, Azerbaijan, Georgia, Iran, Russian Federation and Turkey and its initiates include initiation of Caucasus Mountain Forum (CMF) series, first edition taking place in Georgia on 27-30 November 2016, as well as support to piloting the Caucasus Spatial Data Infrastructure (C-SDI).

With inputs of legal experts some issues were identified in need of further elaboration beyond the initial hazard mapping methodology development, which are of regulatory and institutional nature:

- There is no consensus established yet what regulatory and institutional model can be followed in Georgia, such as who is the client for the hazard mapping task, who is in charge of defining scope of work, and who is entitled to undertake actual mapping. This report provides some recommendations on technical, legal and institutional approaches, which should be pursued further in consultations with key stakeholders.

- The source of funding (presumably national) for such activities is another area where there are debates, but if correctly addressed, could provide long term impetus for harmonised and sustainable hazard mapping process and procedures applied throughout the country. Strong international support would be an asset to generate critical mass of hazard mapping covered areas and further capacity development.

Following consultations were undertaken to discuss and find solutions for outstanding issues:

- Working with NEA specialists to identify methodological issues to define those tasks needing further work. It was possible, for instance, to generate sample synoptic maps based on NEA data.

- Several working sessions were held with key authors of geohazards section from NEA's Geology Department geohazards unit. Similarly, excellent discussion sessions were held with hydrology sector personnel of NEA. Importantly, several consultations were held with NEA Head Mrs. Tamar Bagratia, including joint session with most of the involved personnel, presenting the draft report prior to submission to the task order client.

- NEA is looking forward to recommendations for further SDC SCO support, as well as support measures in the framework of EU-GE Association Agreements in subject areas which are competences of NEA (flooding risk assessments, for instance). Some analysis therefore was extended towards flood directive requirements and participation, experience and input of NEA personnel was indispensable and was reflected in this report.

- GeoGraphic generated sample exposure maps based on NEA data and discussions were held with NEA on these findings and how best to address hazard mapping around exposed communities.

- SDC facilitates CMF 2016 session on hazard mapping (29 November 2016) with integrated presentations by NEA and GeoGraphic on the way forward recommendations in this field for Georgia. This would strengthen institutional consultations held by engaging and gauging the opinion of the research and professional community of Georgia.

- Last but not least, the report and its recommendations are accompanied with the datasets produced by NEA and recompiled by GeoGraphic and further processed to derive sample synoptic products complying with data structuring and formatting schemas established per Swiss guidelines on hazard mapping. The aim is to demonstrate that digital hazard mapping application is indeed technically feasible in Georgia.

3. Report Outline

The main body of this report is structured below in the following manner to address tasks set for this study:

- Specific details of the methodological applied by NEA, outlining main features of the Swiss guidelines on hazard mapping (on the basis of Luzern Canton regulations as an example to follow).
- Tasks performed by NEA and some omitted due to lack of data, resources or other factors.

- Recommendations to add technical solutions and capabilities to enhance and/or transfer HazMap methodology.
- Legal and institutional overview for HazMap field including wider planning and response institutions in Georgia.
- Recommendations for legal & institutional arrangements for furthering/implementing HazMap system in Georgia.
- Consultations with NEA and other critical stakeholders on viability of suggested recommendations.

4. HazMap Methodology (Luzern, Switzerland)

This chapter explains hazard mapping methodology as applied in Switzerland (Luzern Canton case considered as a model to follow). Although main features of the Swiss HazMap guidelines are presented, for illustration purposes the references are also made to regulations in the internet, as well as critical documents are attached as appendixes to this report. This part of the document contains some overview of provisions in Swiss regulations from legal and institutional point of view, in order to seek analogies in Georgian institutional and regulatory framework and proceed with legal analysis and recommendations advisable for the Georgian HazMap system.

Presentation in this chapter closely follows the provisions of the Guidelines for Elaborating Digital Hazard Maps (2012, Richtlinien zur Erstellung digitaler Gefahrenkarten), which is aimed at professionals in the Canton of Lucerne, mandated with the preparation of hazard maps of the Canton.

The quoted document starts with the definition of the parties involved. Client of the hazard mapping task is normally the Municipality (Gemeinde), contract is coordinated by its Natural Resources Department, while job is done by professional organisations/companies experienced in hazard mapping. Municipality's professional community is involved in the project at three opportunities: (i) elaboration of the events cadastre, (ii) presentation and discussion of scenarios, (iii) presentation and discussion of hazard maps.

The requirements and steps to follow during hazard mapping are described further below in the document.

4.1. Guidelines first list and make obligatory to follow all federal regulations concerning all four hazard types considered. These form the general *technical specifications* of the hazard mapping project, mandating the Municipality and its contractors to follow the applicable Swiss guidelines available for each hazard type.

4.2. Initial step in the work is to define the *study perimeter*. Objects anticipated to be impacted in next 15-20 years are defining the perimeter, but study applies to all settlements and objects in the perimeter area. All four hazard processes are addressed in the same perimeter (water, landslides, rockfalls and avalanches). Study should consider only those outside events reaching with influence the predefined perimeter.

4.3. The next steps are defining *depth of processing and documentation*, where the following should be considered:

(i) *events register*, including georeferenced data from so called *StorMe* database of the Swiss Agency for the Environment, Forests and Landscape (SAEFL); various reports and projects, and fire brigade and forestry officers to be consulted as well;

(ii) *protection structures* in the form of table (included in the report) and provided in the form of GIS map;

(iii) *map of phenomena* is created in 1:5,000 scale, displaying all four hazardous phenomena against the simplified backdrop containing only streets and houses (in b&w) for better geolocation of the phenomena, represented in standardized legend (see Appendix II for registry of legend items);

(iv) *hazard assessment*, which should be based on latest feasible state of the art calculations and containing process analysis and scenarios (a) in sources and transit areas and (b) in areas of impact, presented in form of maps (and technical documentation reported in the dossier) for the following *primary* and *secondary* processes (see both listed in Annex 2 of Appendix I) (1) *water*, including flood and debris flow evens for recurrences of 30, 100, 300 years and EHQ, which is *extremely high flood* event, (2) *landslides*, same recurrence rates plus, if undetected, slopes > 20 degrees generally also considered as prone to landslides, (3) *rockfalls*, same recurrence rates, (4) *avalanches*, same recurrence rates; and finally all these maps and respective reports should be validated with key local specialists in a very transparent manner;

(v) *intensity maps* are based on of hazard assessments and are provided for each hazard type separately in exactly the same perimeter and scale 1:5,000, with (i) recurrence periods of 0-30, 30-100, 100-300 years (ii) intensities assigned based on special criteria for each hazard type (see point 6 below and table in Annex 1 of Appendix I);

(vi) *scaled flood maps* are derived for large floods acceding 0.25 m and depicted in 7 classes in 0.25 m steps up to 2 m depth, and are based on results of the hazard assessment scenarios and the 2D modelling of floods for each of the recurrence periods of 0-30, 30-100, 100-300 years, while scale of maps is again 1:5,000, exactly within the same perimeter and with the backdrop of streets and houses, and legend classes of floods, as provided in the Appendix II;

(vii) *process hazard maps* are derived from *intensity maps* for each process type in the same scale and perimeter;

(viii) *synoptic hazard maps* are integrated by superposition of all hazard *intensity maps*, in same scale and perimeter;

(ix) *verified hazard maps* are produced for areas outside mapped hazards by checking/verifying hazard existence;

(x) *protection deficit maps* are also produced through *risk analysis* based on simplest *protection objectives* (differentiated only in *acceptable* and *non-acceptable exposures*) and is presented in legend colour provided in Appendix II containing the registry of legends, and in the same 1:5,000 scale and perimeter;

(xi) *proposals for action* are generated on how to address protection deficit, outlining each action (such as land use planning as a first priority, emergency response capacity, up-keeping the protective forests, protective structures and their maintenance, etc.), drawing them on the maps and visualising expectations how these actions would affect hazard maps;

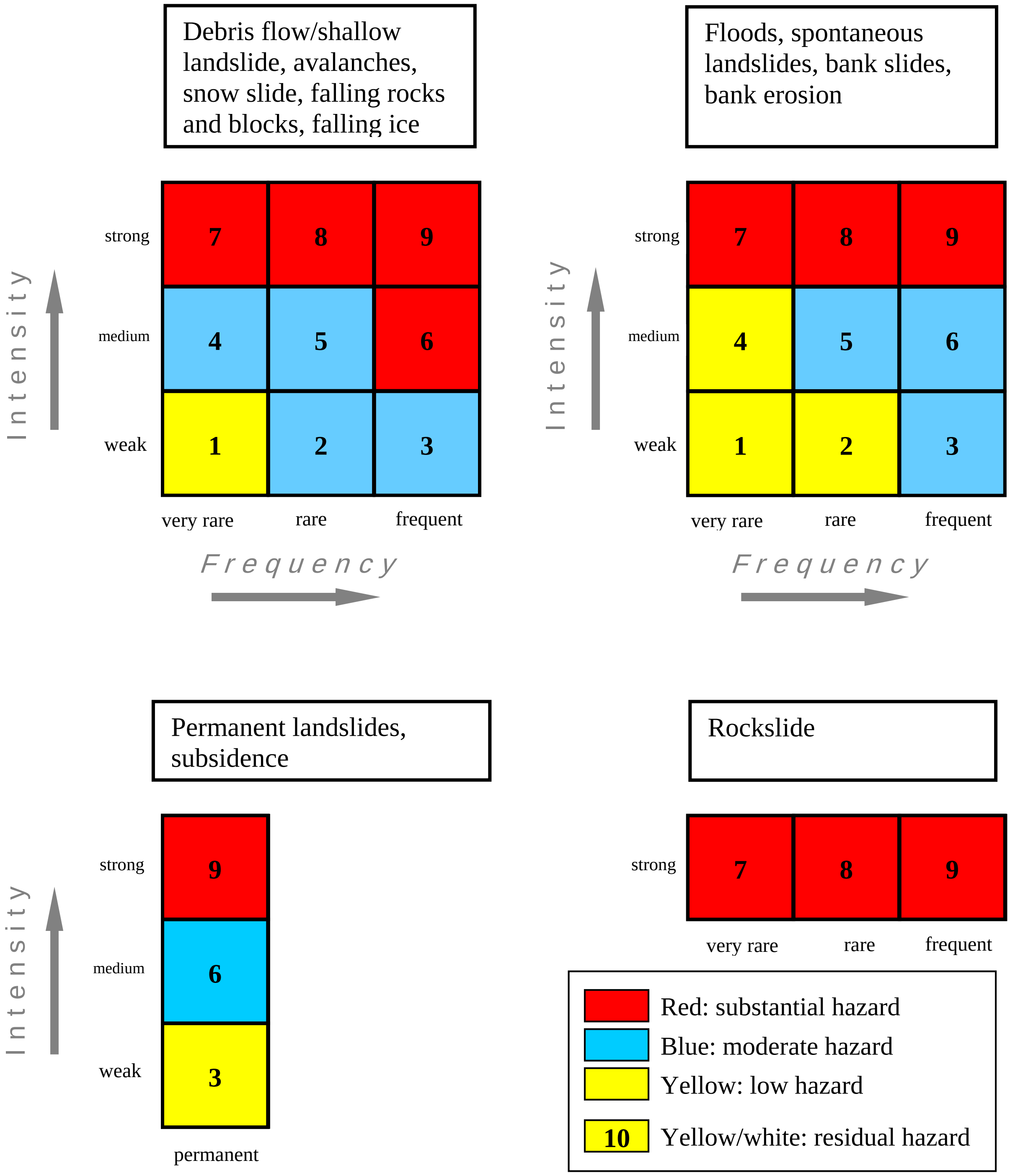
(xii) *dossier* containing all the above described hazard mapping results is to be produced (per Table of Contents (ToC) listed in the Appendix V) and submitted in hard and digital copies, including shapefiles and InterLIS files to contracting authority (municipality) and the Canton (and its Natural Resources Department). The following deliverables are to be produced as part of the Dossier submission:

- Event documentation (forms StorMe, 1 map) [2]
- Map of the phenomena, 1 map
- Intensity maps for each main process types, 3 + 1 (30, 100, 300 yrs. recurrence + EHQ extremely high flood)
- Flood depth scaled maps, 3 + 1 maps (30, 100, 300 yrs. recurrence + EHQ extremely high flood event)
- Process hazard maps, 1 map for each main process type
- Synoptic map of hazards for affected areas, 1 map
- Protection deficit map, 1 map
- Technical report (ToC see in Appendix V).

[2] http://www.bafu.admin.ch/naturgefahren/14186/14801/16419/index.html?lang=de

4.4. *Process types*, as mentioned above include 4 *primary* types (*floods/mudflows*, *landslides*, *rockfalls*, *avalanches)* and 18 *secondary* subtype hazard processes, see both types and their subtypes provided in Annex 2 of Appendix I.

4.5. *Hazard levels* are determined at the 9-cell interplay of intensities and recurrence frequencies, which are defined as: *very rare* = $^{1}/_{300}$ - $^{1}/_{100}$ years, *rare* = $^{1}/_{100}$ - $^{1}/_{30}$ years, *often* = $^{1}/_{30}$ - 0 years.



4.6 *Intensity* levels are defined for *floods* as follows:

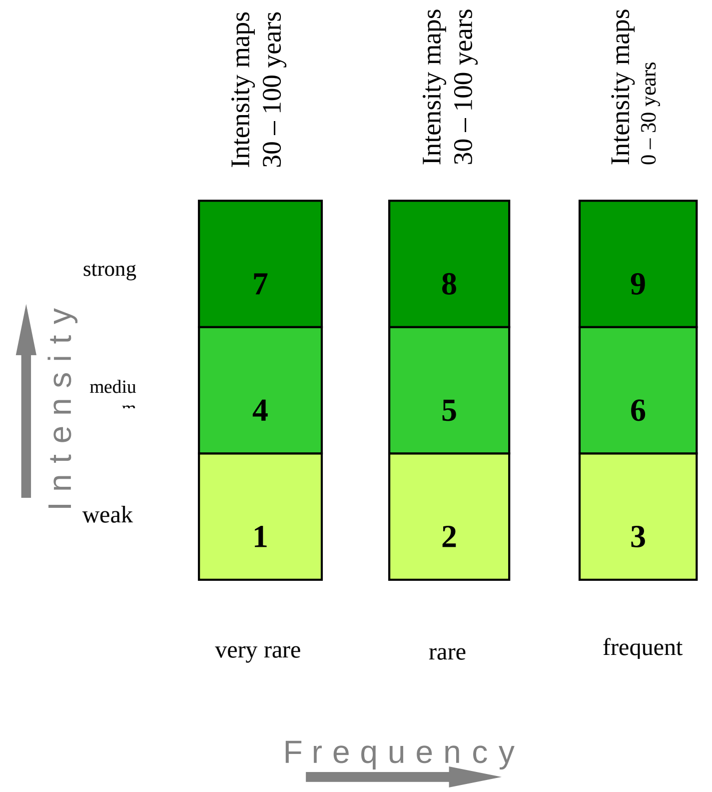
Intensity	Code	Threshold
weak intensity	1	0-25 cm
weak intensity	2	25-50 cm
medium intensity	3	50-75 cm
medium intensity	4	75-100 cm
medium intensity	5	100-150 cm
medium intensity	6	150-200 cm
strong intensity	7	200 cm

For all other hazards the following definitions apply for *intensity level* assignment:

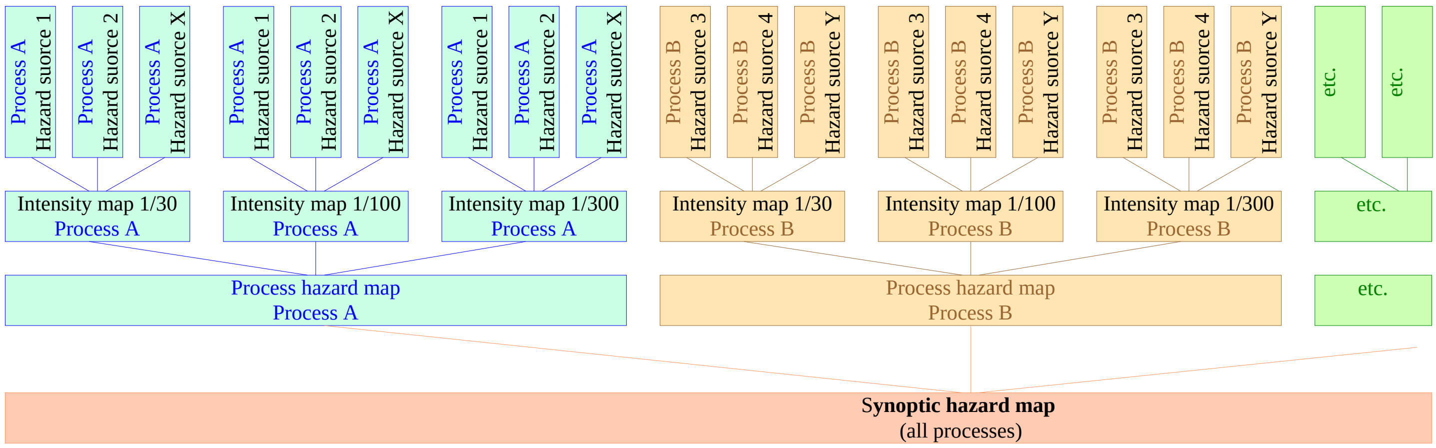
Process	weak intensity	medium intensity	strong intensity
Avalanches, Snow slide	$P <= 3 kN/m^2$	$3 kN/m^2 > P > 30 kN/m^2$	$P > 30 kN/m^2$
Stone and Block shock	E < 30 kNm	30 kNm < E < 300 kNm	E > 300 kNm
Rock fall	does not occur	does not occur	E > 300 kNm
Landslide permanent	v < 2 cm / year	2 cm / year < v < 1 dm / year	v > 1 dm/year *or* strong differential movements
Debris flow	h < 0.5 m *and* v < 1 m/s *and* V < 500 m3	h < 1 m *and* v < 1 m/s *and* regardless of V	h > 1 m *and* v > 1 m/s *and* regardless of V
Landslide spontaneous Bank slide	d < 0.5 m *and* l < 1 m	0.5 m < d < 2 m *or* d < 0.5 m *and* l > 1 m	d > 2 m
Flood including overtopping	h < 0.5 m *or* $v \cdot h < 0.5 m^2 / s$	0.5 m < h < 2 m *or* $0.5 < v \cdot h < 2 m^2/s$	h > 2 m *or* $v \cdot h > 2 m^2/s$
Shore erosion	d < 0.5 m	0.5 m < d < 2 m	d > 2 m
Collapse	If sinkholes are detected, additional investigations should be conducted upon consultation with the Department of Natural Hazards.		

P = pressure
d = medium thickness of erosion (measured perpendicular to the slope surface)
h = flow or deposit amount
l = distance of the sliding movement
v = flow velocity
V = volume
E = energy

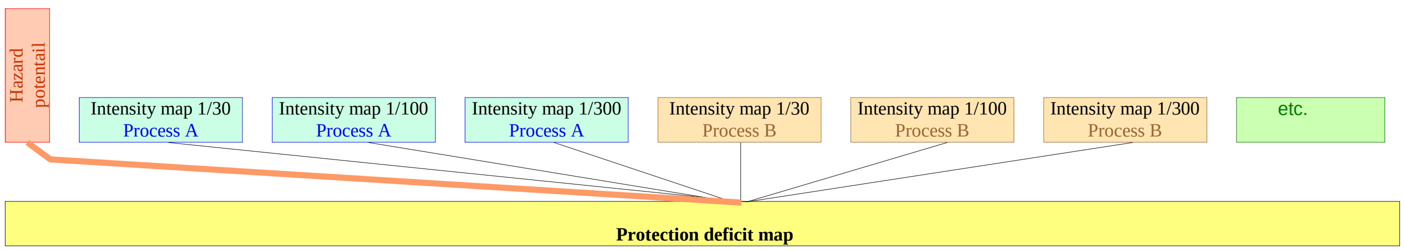
Intensity maps are represented with the following legend:



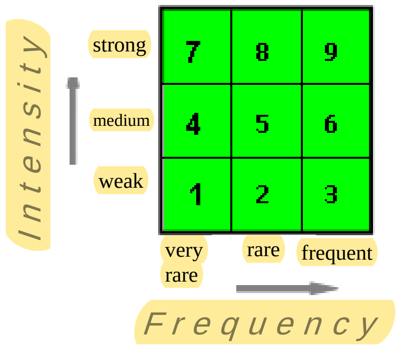
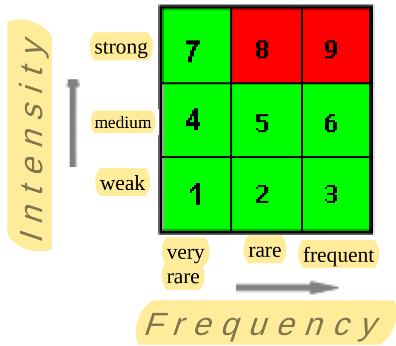
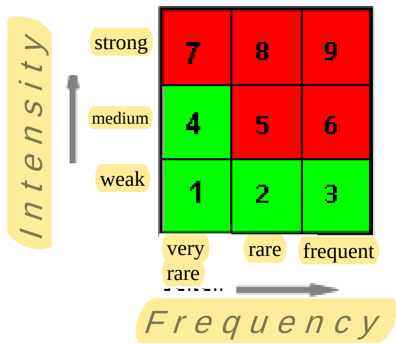
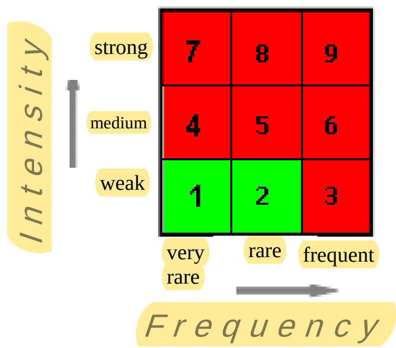
4.7 Derivation of *intensity maps* follow this chart:



4.8. Derivation of *protection deficit maps* follow this chart:



4.9 *Protection objectives* are addressed through the following decision matrix:

Object category				Protection goals
Nr.	**Tangible assets**	**Infrastructure**	**Natural values**	Not tolerated exposure Accepted exposure
1	Location-linked buildings, excluding special risks	Hiking trails, local importance lines, ski and hike route	Alpine meadows, wasteland, natural landscapes	
2	Uninhabited buildings (sheds, willow barn, etc.)	Roads of local and cantonal importance	Forest with significant or special protection function, agricultural land	
3	Temporarily or permanently inhabited individual buildings and hamlets, stables	Roads of national, cantonal or large communal importance, lines of national importance, mountain railways, zones for skiing, ski practice area		
4	Closed residential, commercial, industrial, construction zones	Stations of various means of transport, camping sites, leisure and sports facilities, other large crowds with little protection against the effects of the hazards		
5	Special risks of particular vulnerability or secondary damage			**Each case will be set.**

4.10 *Dataset* is to be provided to the contractor by Department of Geoinformation and Measurement via webpage http://www.gis-luzern.ch/shop/shop33.shtml against the invoiced payment of SFR 500. Provided data includes municipal boundaries 1:10,000, overview plan, property (surveying data, land cover, individual objects, geodetic points), settlement area, streets (roads, highways), railway line, river and sewer networks, hazard maps of neighbouring municipalities (if available), hazard note maps (avalanche, debris flow, landslide, flood overtopping, rockfall areas), all in various formats, such as ArcInfo/geodatabase/shape/InterLIS/DXF/TIF

4.11 *Visualisation* is performed through template maps (supplied as ArcGIS lyr files by the client as well as sample map layouts) and presented below for all needed maps.

Intensity maps

▬ ▬ ▬	Perimeter hazard map (black line, thickness 2¼ points)	
	weak intensity	CMYK 10 / 0 / 25 / 0
	medium intensity	CMYK 30 / 0 / 90 / 10
	strong intensity	CMYK 30 / 0 / 45 / 45

Scaled flood maps

▬ ▬ ▬	Perimeter risk map (black line, thickness 2¼ points)	
········	Perimeter flood map (black line, thickness 2¼ points)	
	Flow depth 0-25 cm	CMYK 0 / 1 / 27 / 12
	Flow depth 25 cm to 50 cm	CMYK 0 / 11 / 38 / 9
	Flow depth 50 cm to 75 cm	CMYK 0 / 21 / 48 / 6
	Flow depth 75 cm to 100 cm	CMYK 0 / 37 / 62 / 5
	Flow depth 100 cm to 150 cm	CMYK 0 / 52 / 73 / 5
	Flow depth 150 cm to 200 cm	CMYK 0 / 66 / 81 / 7
	Flow depth > 200 cm	CMYK 0 / 90 / 90 / 10

Hazard and synoptic maps

▬ ▬ ▬	Perimeter risk map (black line, thickness 2 ¼ points)	
▬ · ▬	Perimeter verified risk note map (black line, thickness 2 ¼ points)	

Hazard and synoptic map

	high hazard	CMYK 10 / 90 / 80 / 0
	medium hazard	CMYK 43 / 8 / 0 / 0
	low hazard	CMYK 0 / 10 / 100 / 0
	Residual hazard (angle 45^0, separation width 1.5 mm, line 2.0)	CMYK 0 / 10 / 100 / 0

Verified hazard note map

	Overtopping	CMYK 90 / 40 / 0 / 0
	Debris flow	CMYK 20 / 38 / 0 / 0
	Landslide processes (broken hatching, no edge line, bottom left right upwards)	CMYK 30 / 0 / 60 / 0
	Fall processes (fat dot grid, no margin line)	CMYK 10 / 90 / 80 / 0
	Avalanche processes (fine dot grid, no border line)	CMYK 60 / 15 / 0 / 0

Protection deficit map

	Perimeter risk map (black line, thickness 2¼ points)	
	Objects with protection deficit	CMYK 37 / 70 / 37 / 0

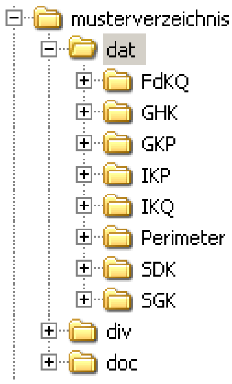
4.12 *Data model* is as follows: flat polygons, no overlapping, gapless aligned borders, no curved lines, 30, 100 and 300 year polygons should be perfectly nested with increasing periods (but exceptions allowed), geometry must be stored with "double-coordinate precision", tolerances 0.02 m. Georeferencing refers to Swiss national coordinate system. The data must be submitted in the InterLIS-, shape- or Geodatabase format.

4.13 *GIS-Concept* is structured around following datasets (against the backdrop of 1:5,000 overview plan):

- Intensity map per process source (IKQ – **I**ntensitäts**k**arte pro Prozess**q**uelle)
- Intensity map per main process source (IKP – **I**ntensitäts**k**arte pro Haupt**p**rozess(art))
- Hazard map per main process source (GKP – **G**efahren**k**arte pro Haupt**p**rozess(art))
- Synoptic hazard map (sGK – **s**ynoptische **G**efahren**k**arte)
- Protection deficit map (SDK – **S**chutz**d**efizit**k**arte)
- Flood map per process source (FdKQ – Über**f**lutungs**k**arte pro Prozess**q**uelle)

Each layer data format, naming convention is provided in the document. Each attribute is defined including its data type and value ranges.

4.14 Data *distribution, documentation and verification* is organised through InterLIS data and directory structure conventions. Reference is therefore made to Swiss Interchange of Land Information System package InterLIS (http://www.interlis.ch/interlis2/download23_e.php), which is considered as data exchange standard. *Data structure* is delivered in "shp" format, for which master tables are provided (file "Mustertabellen.zip) in InterLIS-compatible form. Directory structure is also provided (file "Musterverzeichnis.zip), reproduced below:



Detailed treatment is provided for documentation storage, as well as InterLIS installation.

Document is completed with three Annexes: (1) hazard mapping data model/schema per InterLIS; (2) hazard mapping process diagram and (3) ToC for technical report. Latter two are reproduced in Appendixes IV and V.

Conclusions

There were some technical issues identified from Georgian perspective when analysing Swiss example regulations and tools for hazard mapping. Specifically, certain difficulties were encountered when dealing with InterLIS (http://www.interlis.ch/interlis2/download23_e.php). Our best GIS analysts had hard time compiling and installing this data exchange standard setting software package for land information exchange (apparently including hazard data exchange as well). Despite efforts this did not result in the extraction of date exchange schemas.

Nevertheless, other parts of the document give information, which can be used in file naming and geospatial database field naming conventions, which was successfully repeated and applied to Georgian data provided by NEA. This is important aspect and further communication is needed with Swiss geospatial analysts knowledgeable of hazard mapping GIS data formatting. GeoGraphic is committed to discussing these issues with Swiss specialists as identified. Whatever the outcome, GeoGraphic managed to present NEA's data in the format, resembling the Swiss standard naming conventions for hazard mapping layers.

Despite this issue, it should be stated from the outset, that Swiss hazard mapping guidelines are very attractive, transparent, well thought through and quite easy to apply instrument from methodological point of view and is therefore, recommended for Georgia to follow due to various arguments described in the introductory part. It allows implementation of hazard mapping in similar format, but based on Georgian localised methodologies of hazard rating and analysis. With the time and accumulated experience, measurement methodologies for various phenomena can also be harmonised with Swiss experience. This will take time and resources, but model to follow would provide the organised way forward. It is therefore recommended to copy in a smart manner this mapping guideline and introduce into Georgian system through appropriate regulatory mechanism. NEA could become lead agency overseeing the process from technical point of view. Such regulatory document could easily be approved through ministerial order, for instance, after clearing with all concerned agencies, but such legal issue are better described in the respective part of this document further below.

Recommendations

- Adapt Swiss hazard mapping guideline into Georgian instruction/normative document and adopt with the order of the Minister of Environment and Natural Resources Protection of Georgia (or other regulatory instrument, as recommended in the legal analysis part) upon clearance with all key stakeholder agencies (such as MIA, NAPR, MoRDI, MoESD, MoF), consulting with regional and some municipal authorities as well (e.g. Mestia).
- NEA is proposed as a lead technical agency in charge of approving hazard mapping and reporting task orders (ToRs) prepared by Municipalities, as well as serving as the national repository of hazard mapping database.
- Alternatively (as this is the outcome of the legal and institutional analysis) NEA could be considered as the contracting authority due to potentially insufficient technical capacity at the local level. Still, co-approval of tender and contract scope with the municipal authorities could be pertinent to enhance the ownership of results.
- Coverage can be national as most of these hazard mapping issues are relevant for all parts of Georgia (with the exception of glaciers).
- Municipalities in coordination with NEA could be in charge of hazard mapping contract oversight as well.
- The National Budget is advised to support hazard mapping initiatives in all municipalities, on a priority basis.
- Private sector is advised as implementer of actual hazard mapping task.

It should be stressed, that above recommendations apply to technical part of the instrument, its feasibility for implementation in realistic Georgian 'technical' conditions. Legal and institutional analysis and implications for such recommendation is provided further below in respective parts of the document, produced by legal analysts.

5. European Dimension (INSPIRE)

This section explains INSPIRE directive and characterises data specification dealing with natural hazards. It also provides technical recommendations how to follow Swiss experience but also keep eye on INSPIRE developments and integrating and interfacing implemented Swiss experience-based model with the wider European perspective.

INSPIRE Directive

The INSPIRE is the European Directive 2007/2/EC establishing an INfrastructure for SPatial InfoRrmation in the European Community (INSPIRE). It entered into force on the 15th May 2007 and will be implemented in various stages, with full implementation required by 2019.

The INSPIRE aims to create a European Union (EU) Spatial Data Infrastructure (SDI), enabling the better sharing of environmental spatial information and public access to spatial information across Europe.

INSPIRE is based on a number of common principles:

- Data should be collected only once and kept where it can be maintained most effectively.
- Seamlessly combine spatial information from different sources across Europe and share it with many users and applications.
- Information collected at one level/scale to be shared with all levels/scales.
- Geospatial data for good governance at all levels should be readily & transparently available.
- Easy to find what geospatial information is available, with conditions of acquisition and use.

Geospatial information considered under the Directive is extensive and includes a great variety of themes, defined in its Annexes I, II III http://inspire.ec.europa.eu/data-specifications/2892).

INSPIRE geoportal prototype is available at http://inspire-geoportal.ec.europa.eu.

Institutionally INSPIRE implementation is coordinated by following four European institutions:

- DG Environment acts as an overall legislative and policy co-ordinator for INSPIRE.
- The Joint Research Centre (JRC) acts as the overall technical co-ordinator of INSPIRE.
- EEA is taking on tasks related to SEIS and EIONET in the overall INSPIRE context.
- In addition to Coordination Team, EuroStat acts as the secretariat to INSPIRE Committee.

Data Specification (Natural Risk Zones)

Particularly important for this study are the so called INSPIRE Data Specifications (or Technical Guidelines), developed for almost all ISNPIRE themes, namely the following latest version document is of direct concern for the hazard mapping (see http://inspire.ec.europa.eu/Themes/140/2892):

Natural Risk Zones

http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_NZ_v3.0.pdf
http://inspire.ec.europa.eu/documents/inspire-data-specification-natural-risk-zones-–-technical-guidelines

Presentation of Data Specification/Technical Guidelines on Natural Risk Zones (which is actually Annex III theme under the INSPIRE Directive) follows the executive summary of the document quoted above.

This document defines Natural Risk Zones as areas where natural hazards are coincident with populated areas and/or areas of particular environmental/cultural or economic value. Risk in this context is defined as:

Risk = Hazard x Exposure x Vulnerability

$$(R = H * E * V)$$

Per data specifications, vulnerable areas are characterised according to natural hazards (all atmospheric, hydrologic, seismic, volcanic and wildfire phenomena that, because of their location, severity, and frequency, have the potential to seriously affect society), such as floods, landslides and subsidence, avalanches, forest fires, earthquakes, volcanic eruptions. (See our note below regarding forest fires, earthquakes and volcanic eruptions.)

For some hazards (e.g. meteorological, earthquakes) it is not straightforward task to delineate hazard areas as occurrence depends on complex conditions, covered in other INSPIRE Annex I, II and III themes (e.g. Geology). As a consequence, this data specification does not include the modelling of the processes and scientific methods that are used in the delineation of hazard areas. Data and information included in this data specification take as a starting point the existence of the delineation of a hazard area.

It is also noteworthy that data specification for Natural Risk Zones considers floods in a limited scope, as other data specifications (Hydrography) is specifically dealing with floods in the full context of the European Floods Directive. Nevertheless, all data specifications are mutually compatible, considered in the integrated context by INSPIRE.

The INSPIRE Natural Risk Zones data model includes measured past events and modelled future events. It does not deal with real-time data and respectively events as they are happening. This is the domain of monitoring and emergency response which is considered out of the domain of Natural Risk Zones. (Note: the same is the *proactive* approach of the Swiss methodology, therefore *reactive* response is not in the domain proposed in this report, taking into account that the emergency response is the function of important Georgian ministries/agencies, other than NEA.)

There are 4 key spatial object types that are modelled (approach is just compatible with the Swiss guidelines):

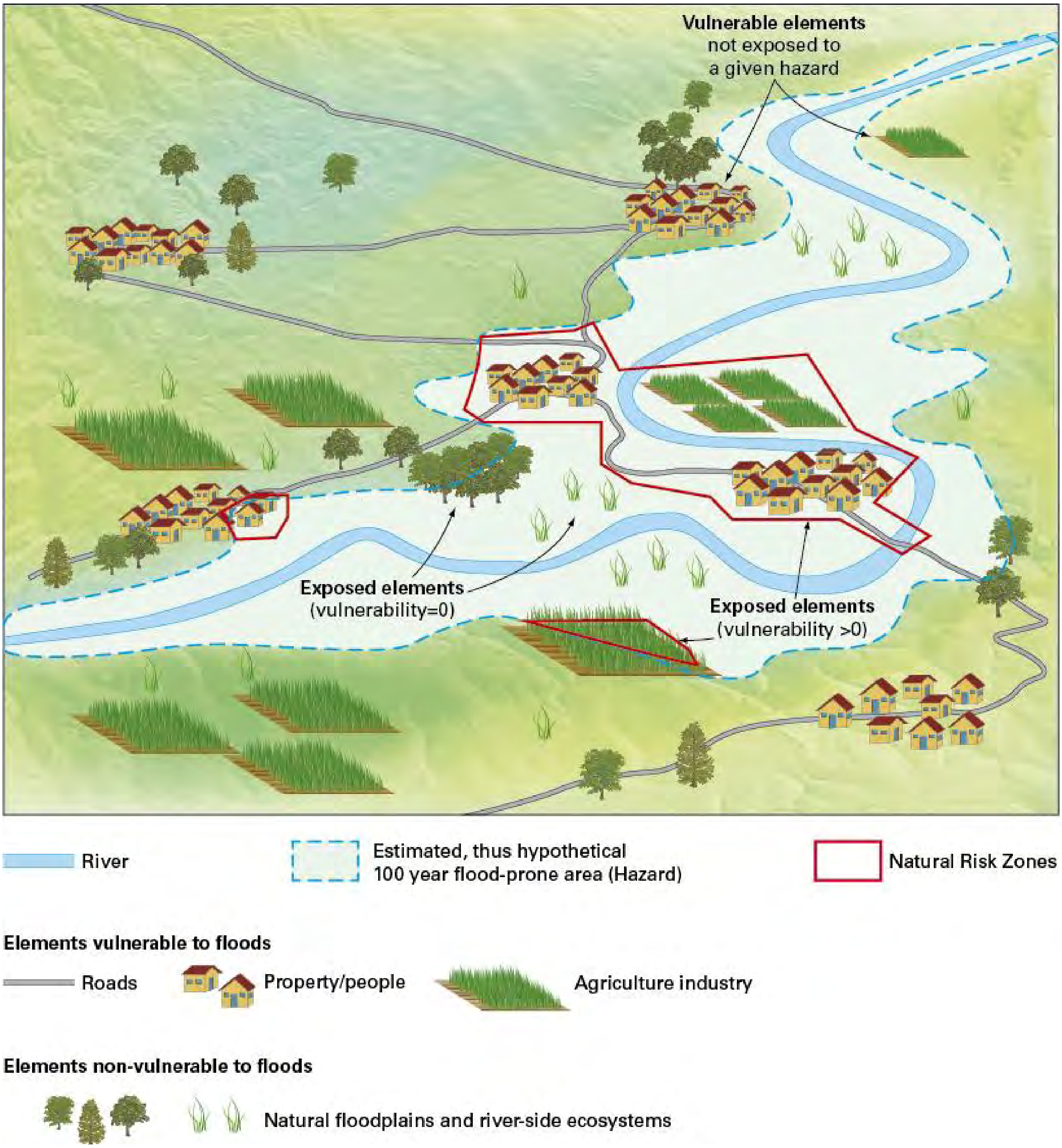
Hazard area
Observed event
Risk zone
Exposed element

Five use cases have been created to demonstrate the fit of the model with specific examples for various hazard types:

Floods (calculation of flood impact, reporting and flood hazard/risk mapping)
Risk Management Scenario (an example from a national perspective)
Landslides (hazard mapping, vulnerability assessment and risk assessment)
Forest fires (danger, vulnerability and risk mapping)
Earthquake insurance

(It is noticed hereby, that Swiss approach does not include forest fires and earthquakes in their hazard mapping guidelines, and as mentioned subject are extremely important for Georgia, they should be treated separately on a standalone basis in Georgian reality as well.)

The approach is visualised in the following popular diagram shown on the figure below (conceptual process illustrated below is compatible with the approaches in the Swiss HazMap guidelines):



Main concepts in the Natural Risk Zones model for INSPIRE

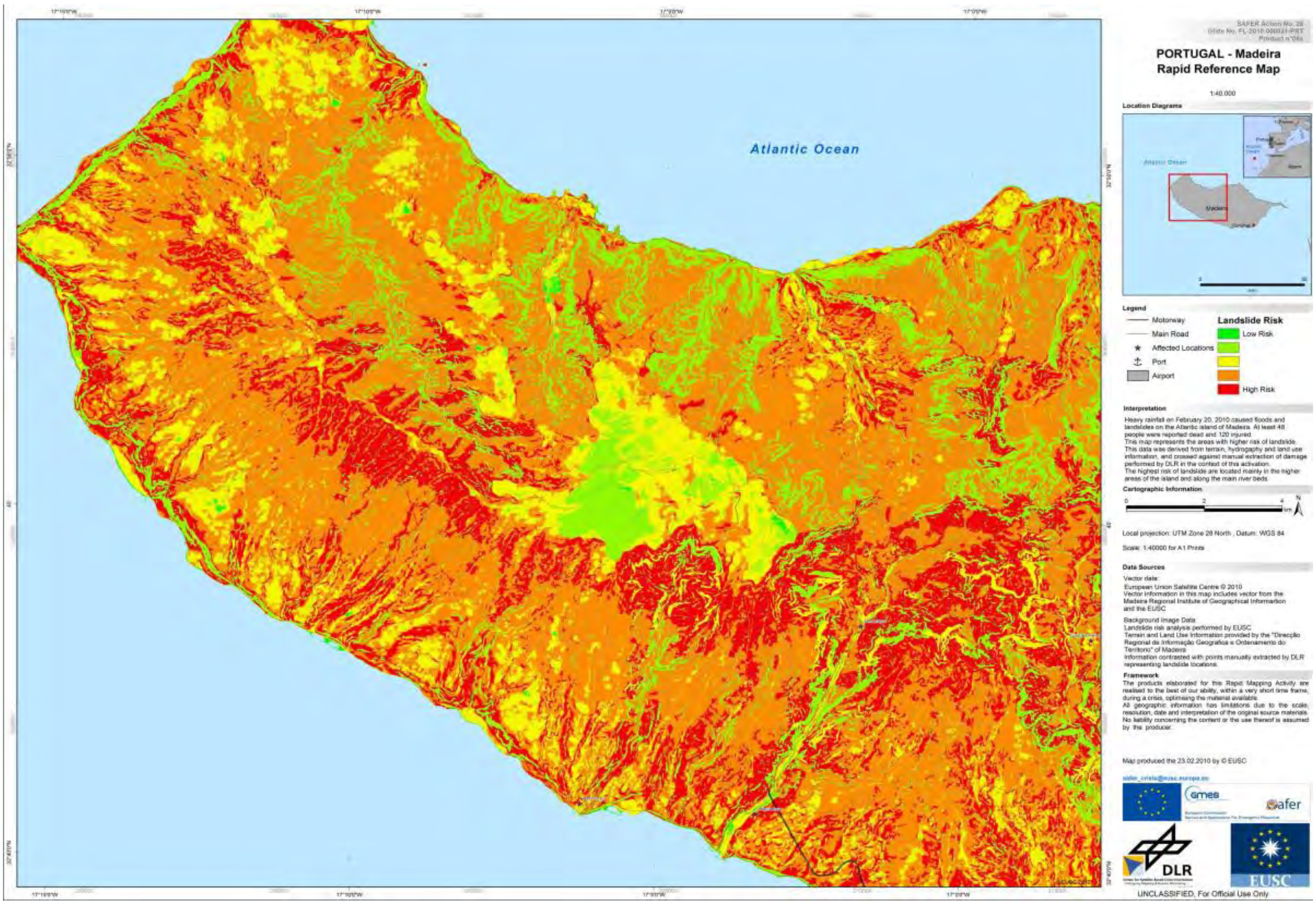
It should be stressed, that the scope of this data specification is very large, covering several natural hazard domains (floods, landslides, etc.) and it is therefore considered impractical to define mandatory styles for displaying the data for each domain. Example to follow is provided in the form of the representation schema used in France for flood risk and hazard mapping and is reproduced below:

OBJET	ATTRIBUT CARTOGRAPHIQUE	VALEUR	Style trait	Couleur trait	Style trame	Couleur trame
2 – 1 – 1 -	Risk basin	polygone		471	sans	sans
2 – 1 – 2	Outlet basin					
	Type of slope	01 Low		277		277
		02 Moderate		306		306
		03 High		286		286
	Run-off ratio	01 Small		277		277
		02 Average		306		306
		03 Big		286		286
2 – 2 – 1	Geomorphological units					
	Type of area	010 Minor bed		noir		231
		020 Medium bed		noir		286
		030 Major bed		noir		306
2 – 2 – 2 -	Outlet					
	Type of outlet	010 Alluvial terrace		noir		100
		020 Outlet		noir		511
2 – 3 – 1 -	Flood area					
	Type of flood	01 Decenial flood		360	sans	-
		02 Centenial flood		150	sans	-
		03 Historic flood		214	sans	-
	Flood determination	01 Modeled		252		252
		02 Observed		252		252
		03 Calculated		252		252
		04 Assessed		252		306
2 – 3 – 2 -	Potential flooded area			306		306
2 – 3 – 3 -	Heights field					
	Indication of water height	01 : 0 à 0,5m		noir		277
		02 : 0.5 à 1,0m		noir		306
		03 : > 1,0m		noir		286
2 – 3 – 4 -	Field of speeds					
	Indicate speed of flow	01 0 à 0,5m/s		noir		277
		02 0.5 à 1,0m/s		noir		306
		03 > 1,0m/s		noir		286
2 – 3 - 5 –	Hazard area					
	Type of area	Low		359		359
		Moderate		383		383
		High		150		150
		Very high		214		214
2 – 3 - 6 -	Zone of vulnerability					
	Type of stakes	Low		359		359
		Moderate		383		383
		High		150		150
		Very high		214		214
	Land use	01 Agriculture	sans	-		102
		0[illegible] Dense urban node	sans	-		477
		0[illegible] Grouped habitat	sans	-		150
		0[illegible] Scattered habitat	sans	-		141
		0[illegible] Gathering places	sans	-		319
		04 Sensible facilities	sans	-		251
		0[illegible] Natural spaces	sans	-		341
2 – 3 - 7 –	Risk zone					
	Type of risk	0[illegible] Low		359		359
		0[illegible] Moderate		383		383
		0[illegible] High		150		150
		04 Very high		214		214

Representation styles for flood risk and hazard mapping (Source: France Ministry of Environment)

(Again, Swiss approach is quite compatible and bit simpler, therefore mapping styles are used as initial model for Georgia, with subsequent transition to INSPIRE symbology, if and once defined as mandatory.)

Reader is referred to entire document to get into technical details of this data specification. We are concluding this introductory section referring to the series of interesting use cases considered in Annex B of the data specification. Of particular interest could be the Annex B.5 Landslides, which is culminated with the example of Landslide Risk Assessment, integrating hazard area and vulnerability assessments into a landslide risk map, which is illustrated by the map provided below and produced by EUSC (see figure below).



Landslide risk zone map of Madeira, Portugal
(Source: European Union Satellite Centre EUSC https://www.satcen.europa.eu, see at https://www.zki.dlr.de/system/files/media/filefield/map/low/EUSC_20100222_Portugal_Madeira_lanslide_risk_a_low.jpg)

Similar approaches are advocated in this review document as well (see Footnote 3) in order to shorten period needed for the accumulation of the observation data to define the spatial extent of the evens/phenomena, such as landslides.

INSPIRE and Georgia

Above outlined and several other INSPIRE data specifications (see them all at http://inspire.ec.europa.eu/data-specifications/2892) would be important for Georgia in the context of building up its INSPIRE-compliant National SDI (NSDI) framework for Georgia.

Indeed, with SIDA funding, the National Agency of Public Registry of Georgia, supported by its European partners, is implementing NSDI development project in Georgia (to be completed in 2018). Further details on developments and processes at this initial stage are covered on the webpage http://nsdi.gov.ge, operated by the National Agency of Public Registry (NAPR) under the Ministry of Justice of Georgia, including information about State Commission on NSDI Establishment and Development (chaired and co-chaired respectively by MoJ and MoE Deputy Ministers), formed per Resolution No. 262 of the Government of Georgia of 9 October 2013. This legal act mandates NAPR to coordinate NSDI development, form the Secretariat to NSDI State Commission, establish and coordinated thematic working groups (currently 6: legislation, PR, business model, GIS, IT and education). Some prototype for the NSDI geoportal is available at http://nsdi.gov.ge/en/Maps. Importantly, Article 3 of the GoG Resolution No. 262 is almost entirely devoted to mandating the NSDI of Georgia to become INSPIRE-compliant.

It is important to note therefore, that as Georgian NSDI is to be built in compliance with INSPIRE, all spatial data infrastructure instruments, including hazard mapping, are contemplated as key components of the NSDI and every development in the field of hazard mapping data collection & sharing, including metadata, should take into account NSDI development direction and processes. Intense cooperation and coordination with the NSDI stakeholders is strongly urged in any decision-making affecting the prospects of such cooperation and coordination. NEA is part of the NSDI process and quite sensitized to NSDI establishment and development process, that is positive development.

NEA per applicable data distribution regulations was required to sell its data products per established price lists, contributing into NEA's budget in addition to core funding from the national budget, but with the enactment of 2014 order (see below), the situation has changed further and funding of NEA since 2014 comes almost entirely from licensing sources. With the approval of the named Decree No 502 dated 18 August 2014 and annexed service price lists (15 total) for all possible data provided by NEA instead of free and open access policy the business model of the data selling public authority is now fully established, see links to Georgian legal gazette Matsne:

https://matsne.gov.ge/ka/document/view/2465275 (Decree)

https://matsne.gov.ge/ka/document/download/2465275/0/1 (***Geology***)
https://matsne.gov.ge/ka/document/download/2465275/0/2 (Pollution, including aquatic biology)
https://matsne.gov.ge/ka/document/download/2465275/0/3 (***Hydrometeorology historic data***)
https://matsne.gov.ge/ka/document/download/2465275/0/4 (***Climatology data***)
https://matsne.gov.ge/ka/document/download/2465275/0/5 (***Climatology studies***)
https://matsne.gov.ge/ka/document/download/2465275/0/6 (***Hydrometeorology calculations***)
https://matsne.gov.ge/ka/document/download/2465275/0/7 (***Hydrometeorology prognosis***)
https://matsne.gov.ge/ka/document/download/2465275/0/8 (***Hydrology data streams***)
https://matsne.gov.ge/ka/document/download/2465275/0/9 (***Hydrology fieldwork***)
https://matsne.gov.ge/ka/document/download/2465275/0/10 (***Hydromorphology studies/designs***)
https://matsne.gov.ge/ka/document/download/2465275/0/11 (***Hydrometry gauge installation***)
https://matsne.gov.ge/ka/document/download/2465275/0/12 (Cyclamen, Galantus assessments)
https://matsne.gov.ge/ka/document/download/2465275/0/13 (Web-advertisements meteo.gov.ge)
https://matsne.gov.ge/ka/document/download/2465275/0/14 (Licensing services)
https://matsne.gov.ge/ka/document/download/2465275/0/15 (Free public data list)

Parameters of direct relevance to hazard mapping are highlighted in ***bold-italic***, therefore most of NEA data is highly relevant for natural hazard assessment. It seems necessary to resolve data pricing issue at least for contractors as well as for public distribution of hazard mapping results through NSDI and NEA portals.

Conclusions and Recommendations

- It is not yet mandatory for Georgia to follow INSPIRE Directive, but the Government of Georgian empowered the national cadastral agency (NAPR) to lead the INSPIRE process and NEA is party of this national process of creating NSDI.
- Implementation of the Swiss model HazMap methodology could contribute into NEA input into NSDI.
- INSPIRE data specification thematically goes beyond 4 hazard mapping areas considered per Swiss guidelines and includes forest fires, earthquakes and volcanic eruptions in addition to floods and gravity processes and avalanches. Georgia is advised to follow Swiss subset of hazards and to implement forest fires and earthquakes hazard assessment as standalone instruments beyond general hazard mapping method.
- Hazard mapping styles are not mandatorily proposed in INSPIRE and shown use case examples are quite similar and bit more complicated than Swiss approach, therefore Swiss mapping styles are advised as an initial model for Georgia, with subsequent transition to INSPIRE symbology, once defined as mandatory.
- In all other aspects INSPIRE and Swiss hazard methodologies are quite equivalent.
- Landslide use case considered in data specifications can be useful for Georgia to follow to define hazard events.
- NEA business model of revenue generation by selling data might be hindrance unless its contractors (and public, as necessary) are provided with free access (or against modest 'processing' cost) to respective data products.

6. HazMap Methodology as Applied (NEA) and Data Gaps

This section describes in a bullet point as well as concise narrative format hazard mapping methodology as applied by NEA based on Swiss experience and accommodated to Georgian conditions.

It is worth mentioning, that several trainings were conducted by Swiss specialists introducing basic principles of hazard mapping concepts, such as, intensity, return periods, map colour coding, synoptic maps, protection structures and deficit mapping, etc. NEA was given freedom with the task to elaborate the system most suitable for Georgia.

Presented in this chapter are some gaps identified by GeoGraphic's GIS analysts when reviewing the data and reports provided by NEA and identified range of issues both with data (gaps) and methodologies applied. Generic issues identified are followed with issues concerning each thematic domain of hazard mapping considered by NEA.

Prior to presenting this analysis, we first remind the main steps of the Swiss hazard mapping methodology (which are described in more detail above and referenced in Appendices as well):

Generic Issues

- Perimeter of the hazard map
- Event register
- Protection building cadastre
- Map of the phenomena
- Hazard assessment
- Intensity maps
- Scaled flood maps
- Process hazard maps
- Synoptic risk map
- Verified risk note maps
- Protection deficit maps and hazard analysis
- Proposals for action
- Dossier

We start with general review and findings against above list in bullet point format:

- Precise hazard perimeter not defined as a formal GIS contour at the outset of the process (nevertheless, certain elements implemented in consultation with SCO program and local stakeholders when delineating roughly the communities considered and setting certain rectangular contours for hazard mapping).
- Scenarios and hazard typology not developed at this stage per methodology, though outlined in general terms.
- Data was processed, but this is in many cases presented in the body of the report(s).
- Maps of phenomena provided for all required areas (4 in Swiss methodology) except for avalanches and floods.
- No intensity data and maps provided.
- Recurrence data and maps not provided, or if provided not for same recurrence periods as Swiss guidelines (which are 30, 100, 300 years), though NEA strongly supports the idea to start collecting hazard data in a manner similar to Swiss methodologies so that in the future intensities and recurrence rates can be mapped (may require decades of records colelction, so time to start is now).[3]
- Consequently no 3 x 3 matrix classifications provided per hazard source.
- Hazard maps are provided, albeit not based on intensity and recurrence, but through certain Georgian methods (and certainly applying elements from Swiss methodology) and NEA should be commended for performing this analysis based on expert judgement and alternative set of criteria (for some phenomena), as this allowed GeoGraphic the production of integral (synoptic) results as well.
- Synoptic maps not provided, though as mentioned above, hazard maps are availed and could have been

[3] It is also worth noting, that use of modern modelling (such as the combination of 1D/2D flood models) and remote sensing tools (such as freely available Sentinel imagery and tools such as SNAP) to process through radar interferometry and/or GEO-Object-Based Image Analysis (GEOBIA) and other instruments/methods could be quite cost-effective way to derive geohazard intensities and recurrences/frequencies within the shorter periods of event time series.

integrated and was not performed for the reason quoted that it was not directly requested (done by Geographic using NEA hazard source maps).
- No flooding maps provided in the same level ranges as required by Swiss guidance.
- Cadastre for protection structures was not provided in the map format (but are described in the report).
- Consequently protection deficit maps cannot be generated.
- Action proposals not provided either (for this protection deficit maps are required).
- Dossier not compiled in line with Swiss outline, albeit there is a potential to use provided reports and assemble them into Swiss specification (see HazMap Recommendations).
- Source defining 'point' data provided only for gravity processes.
- Cadastre of the letter differs substantially from Swiss format (StorMe forms are advised to follow, see HazMap Recommendations and Annexed StorMe forms to Appendix VI).[4]
- The phenomena are subdivided into 5 source types (but are same as Swiss 4, which unite floods and debris-/mud-flows).[5]
- Swiss typology is of two levels, while in Georgian data only landslides have second subtype level provided in reports (but typology again differs) and this is not reflected in GIS spatial layers.

Avalanches

Through desk study (DEM, slope exposition and slope aspect analysis) avalanche prone areas were identified followed by field work and interviews with local population, upon which hazard maps were produced together with general characterisation of 27 avalanche areas. The avalanches were grouped then according to territorial principle, describing existing conditions. Map was provided (orthophoto with avalanche areas and their numbering), and mitigation measures proposed for each avalanche.

Perimeter of the hazard map – not defined as a detailed contour.
Event register – there was no inventory of phenomena in recent years, therefore interviews with population was used as the basis for the information collection.
Protection building cadastre – not provided.
Map of the phenomena – not provided.
Hazard assessment – not provided.
Intensity maps – not provided.
Process hazard maps – there are inaccuracies (map, textual report and GIS contain variable information). Yet another advantage of digital mapping of hazards is to avoid such discrepancies.

Flooding

Perimeter of the hazard map – not elaborated as a detailed contour.
Event register – provided.
Protection building cadastre – is provided at the end of the report, describing hazardous locations (without map).
Map of the phenomena – not provided.
Hazard assessment – provided, but in a manner quite different from Swiss methodology (e.g. recurrence periods are different 10, 30 100 years, while it is advised by Swiss approach to have 30, 100, 300 years).
Intensity maps – not provided.
Scaled flood maps – report informs that flood levels were provided, but map could not be identified.
Process hazard maps – zones provided for 10, 30, 100 years recurrence (rather than scaled maps for flood levels as in Swiss methodology).

Enguri River Basin is characterised, map provided (catchment on orthophoto), but boundary is not provided in GIS data. This is followed with description of the catchment, the river and its tributaries with numerous hydrological parameters. This is followed by the methodology of zoning of flood areas.

[4] http://www.bafu.admin.ch/naturgefahren/14186/14801/16419/index.html?lang=de
[5] Due to institutional setup reasons (debris flow is under geology sector rather than water/flood) NEA is inclined to consider debris flow as a gravity process, rather than water process, but from data processing point of view one could still follow Swiss data collection and visualization guidelines as this simplifies implementation according to Swiss methodology on data processing, visualization and sharing with public, without any changes in traditional data collection institutional arrangement at NEA. GeoGraphic's experience while producing synoptic maps is that visualization of floods and debris flows can better be combined together as 'linear/longitudinal' type polygon objects.

It is claimed that flood hazard and vulnerability assessment was conducted, but it is not exactly the case. Zoning is based on numerous materials, which result in subdivision into three zones of high, medium and low risk zones. Each one of these zones is described and protection measures in terms of infrastructure outlined. This is then followed by description of planning policies and environmental considerations.

Hydrological survey was undertaken through field work. This included 4424 m section of Mestiachala river with 21 cross sections, Mulkhura River in Mulkhi community where along 2600 m section 7 cross sections measured, 7176 m section of Nakra River with 11 profiles, 15351 m section of Nenskra River with 17 cross sections done, and 9044 m section of Dolra River with 14 cross sections.

This is followed by discharge calculation formulas and maximal water level calculation formulas. Tables with main hydrological parameters provided for all 4 rivers. What was done and what needs to be done is described.

Water levels are depicted on maps, data of which were not provided in files. Generally files provided are incomplete, there are only hazard zones for Dolra, Nakra and Nenskra rivers. 10, 30 and 100 year return periods are used for zones calculated, which differs from Swiss approach with regard to recurrence times, and in this methodology modelled flooding levels are used for determination of zones and colour graded maps.

Changes of river levels for respective recurrence times is provided in 2 tables, but data is not provided in maps, rather in the form of the report. No GIS files and maps are provided, although text reports that such maps were developed, while in reality only ‘zones’ map is provided.

Gravity processes

The following has been completed:

- Zoning maps for 6 communities with regard to landslides, mudflows and rockfalls, which were characterised in red, blue and yellow colours respectively showing the high, medium and low hazard areas.
- Spatial layout of landslide, mudflow and rockfall as event maps provided (depicts events using non-scaled symbols). Numbering of these symbols corresponds to numbering of process maps (cadastre forms were compiled for 119 landslides, 92 mudflows and 137 rockfall events).
- Textual report as attachments contain process classification criteria (in matrix form), as well as statistical information about meteorological conditions.
- Graphical part of the report contains hazard classes/zones (8 sheets) and event maps (5 sheets) for 6 communities of Mestia Municipality.
- As a separate volume of the report cadastre/ inventory of landslides, mudflows and rockfalls is presented.

The following research methodology was applied:

- Collection of inventory/baseline data.
- Identification of hazard events (classifying landslide, mudflow and rockfall processes).
- Elaboration of recurrence rates/frequencies.
- Elaboration of the map of the events of landslides, mudflows and rockfalls.
- Determining hazard levels based on the classes/zones of influence of these events/processes.
- Classification of areas with respect of qualifications per hazard level.
- Large number of events is registered and database provided.

Classification was performed based on Swiss methodologies with adaption for Georgian conditions, but map was provided only for main hazard type (landslides), not for sub-types and not indicated which landslide sub-type is located where.

The following classification scheme was applied:

- With regards to strength of the landslides following thresholds were provided: < 2 m (surface), 2-10 m (not deep) and > 10 m (deep landslides).
- With regard to intensity of permanent landslides – < 2 cm/year (low), 2-10 cm/year (medium) and > 10 cm (high).
- With regard to intensity of spontaneous landslides – < 2 cm/year (low), 2-10 cm/year (medium) and > 10 cm (high).

At the same time:

- Intensity map not provided.
- Protection deficit map not provided
- Recurrence periods not classified
- Data provided
- Events cadastre provided
- Criteria for hazard zones (hazard classes) defined
- Hazard maps provided
- Files provided, but there are some inconsistencies, such as areas identified in the form of tables in the report do not coincide with number of areas included in the GIS data

When comparing with other items in Swiss methodology:

Perimeter of the hazard map – not provided.
Event registry – provided.
Protection building cadastre – described in the report, but not provided in GIS map form.
Map of the phenomena – provided in certain form.
Hazard assessment – provided, but different from Swiss methodology (no recurrence etc.).
Intensity maps – not provided.
Process hazard maps – zoning map provided.

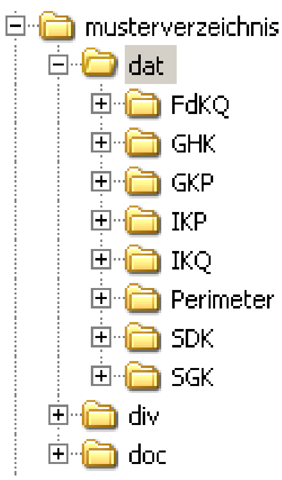
Provided report for Mestia Municipality contains geographical characterisation (topography), geological compositions, hazardous geological processes (landslides, mudflows, rockfalls), their impact on settlements and demography. Prognosis for development of processes and scenarios. Zoning (colour coding) of the processes according to hazard level. Recommendations for measures to be taken. Measures for protection from landslides (general treatment, no maps shown). Measures against mudflows (measures are specified in more details). Measures against rockfall (indicated with each cadastral item for 119 landslides, 92 mudflows and 137 rockfall events). High, medium and low hazard zones indicated with recommendations on rational land use in these areas.

7. HazMap Conclusions and Recommendations

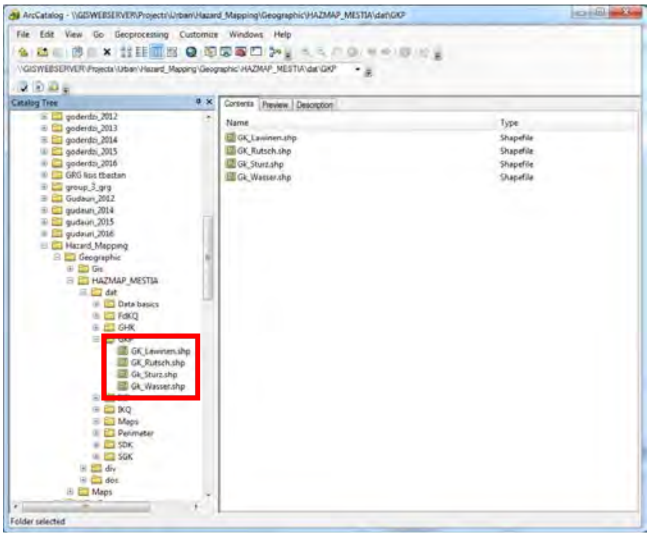
This chapter provides certain conclusions on the experience of NEA and then GeoGraphic with regard to hazard mapping methodology application. Database structure of the Swiss methodology described in Section 4 above is used to illustrate, that presentation of NEA data in the same structure is possible, and this structure is used to illustrate what data could have been generated and what is outstanding.

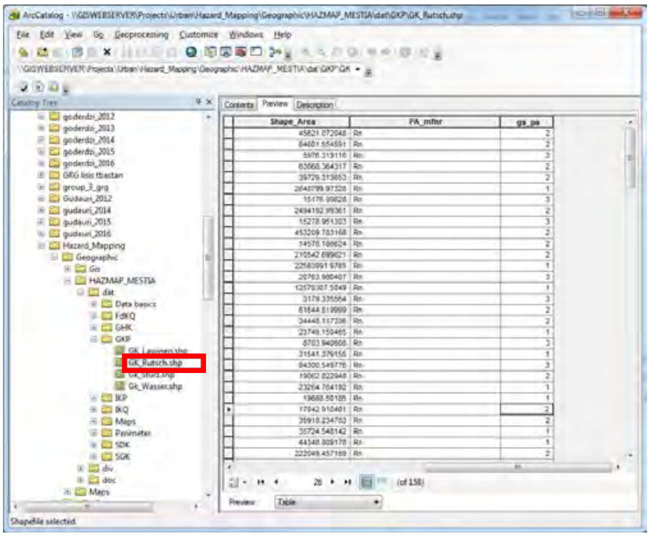
Conclusions

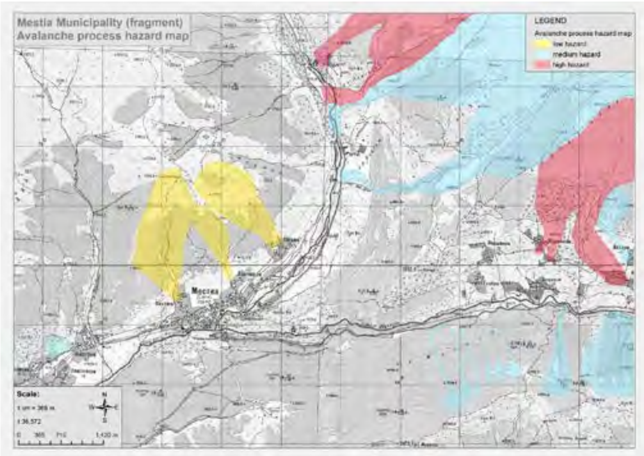
Reiterating the Swiss database and directory tree (i.e. in which data format and structure NEA's maps were converted by GeoGraphic without using InterLIS package), it is visualised below what is provided or what is not by NEA:

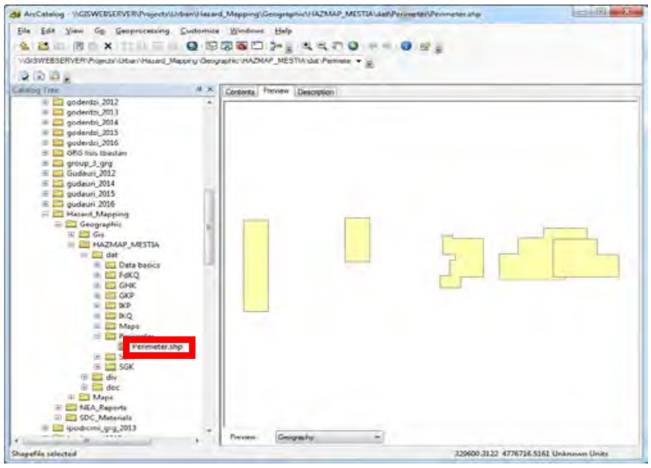


FdKQ – Risk map, scaled flood maps per process source – not provided.
GHK – Verified risk note map – not provided.
GKP – hazard map per main phenomena type – provided.

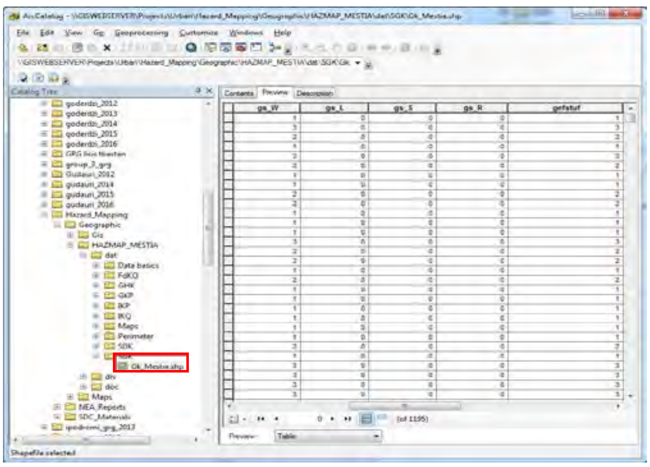


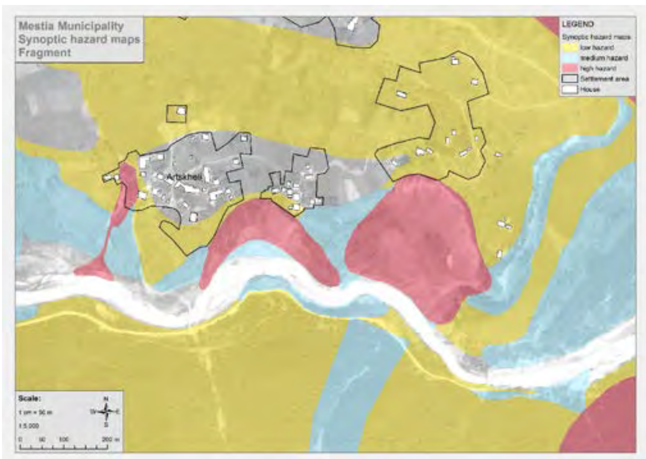






IKP – Intensity maps per main processes – not provided.
IKQ- Intensity maps per process source – not provided.
Perimeter – provided in a simplistic form.





SDK- Protection deficit map – maps not provided.
SGK- Synoptic hazard map – could be generated by GeoGraphic based on NEA materials

Recommendations

There were thus range of issues identified with data availability and processing. Main weakness is that there are no intensity and return period calculations done, which means no 9-cell classes can be defined for intensity/return period, hence no hazard classes can be defined from NEA data.

Nevertheless, NEA, based on its own methodology, managed to classify 4 hazard sources (flood/mudflow, landslides, rockfalls, avalanches) into hazard classes 0, 1, 2 and 3 (no, low, medium and high hazard, respectively).

NEA did not produce Synoptic maps, but based on their hazard classification maps for each hazard source, GeoGraphic managed to model synoptic map production, demonstrating that certain integral result can be produced.

It was also possible to demonstrate the concept of exposure maps for human settlements, but these are not based on actual land use or building use data, just demonstrated using GeoGraphic's spatial data layers (orthophoto and vector) of houses in Svaneti.

These maps were produced with the naming convention explained in Swiss guidelines and with colour coding of legends from the same source. Next few pages reproduce these maps, which demonstrate that at least some results can be produced with available data and that Swiss methodology actually can work in Georgia (see illustrative maps on next few pages, starting from events map, continued with synoptic mapping and finishing with geoportal demo, refer to figure captions for details).

Maps were produced using backdrop of old topographic maps in b&w palette to mimic same layout as instructed in Swiss guidelines and as provided on the Luzern Canton hazard mapping Web-GIS portal.

GeoGraphic accompanies GIS mapping with Web-GIS setup to demonstrate the proof of concept feasibility of sharing in a manner similar to Swiss portal the Georgian hazard mapping results with accessibility in the internet. Demonstration is envisaged at the CMF conference utilising Caucasus SDI open source portal currently under development in cooperation with University of Geneva and/or, alternatively, through ArcGIS server setup.

As for other findings, it is recommended to rearrange and integrate produced reports in the format of Swiss technical report (see Appendix V) so that complete Dossier is produced e.g. for pilot study in Mestia communities.

Integration with national level mapping of hazardous phenomena is also required (re: Geoportal of Natural Hazards and Risks of Georgia at CENN webpage http://drm.cenn.org/index.php) with the clear understanding of major differences in scales. It is therefore desirable that this geoportal, now hosted by CENN, is transferred to NEA server facilities and further maintained and publicly disseminated by NEA. CENN may wish and certainly can maintain its portal as a mirror of the NEA geoportal.

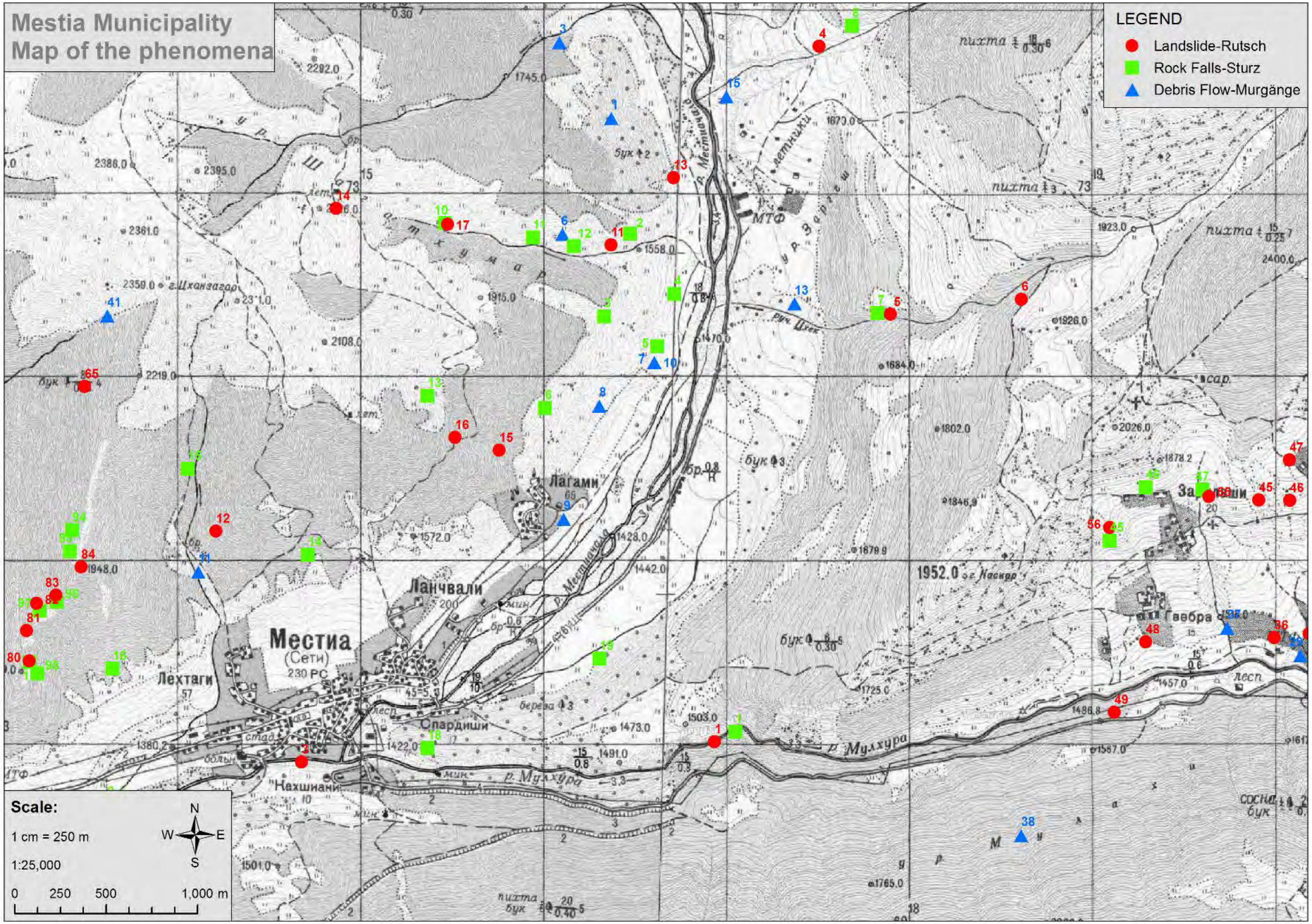
Another recommendation is to critically review and establish forms similar to StorMe, advised by Swiss methodology, which are Annexed to Appendix VI as initial samples for consideration.[6]

It is also advised to consider during Hazard Mapping two-level typology, as it is considered in Swiss methodology: main-type processes and sub-type processes (see Appendix 1).

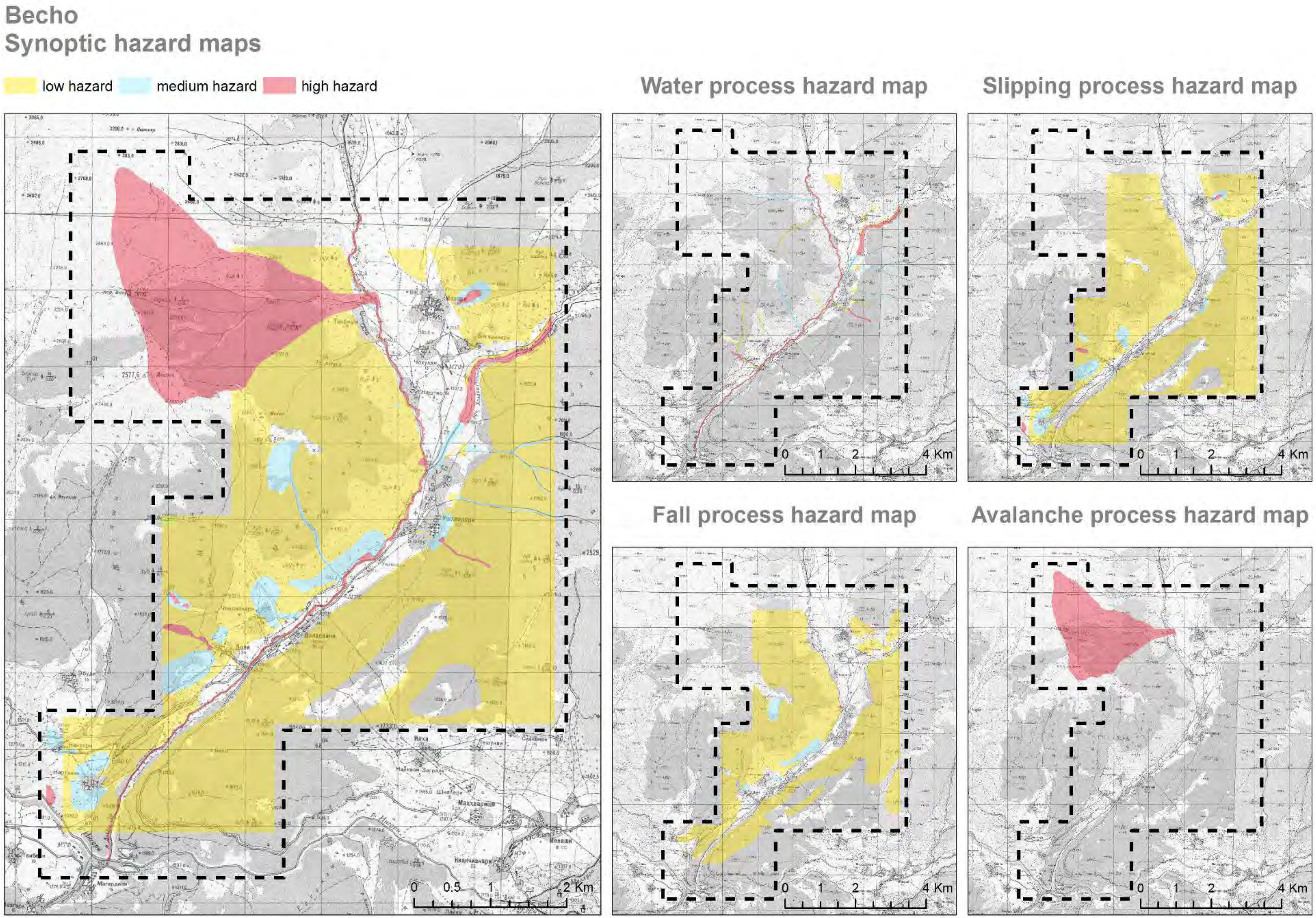
Yet another advantage of digital mapping of hazards is to avoid such discrepancies as different numbers on hazard maps and in the technical report/dossier.

Last but not least, Georgia (NEA in particular) is advised to introduce/regulate standard tender scope for the nationally harmonised hazard mapping (adapted version is provided in Appendix VI HazMap Tender Scope).

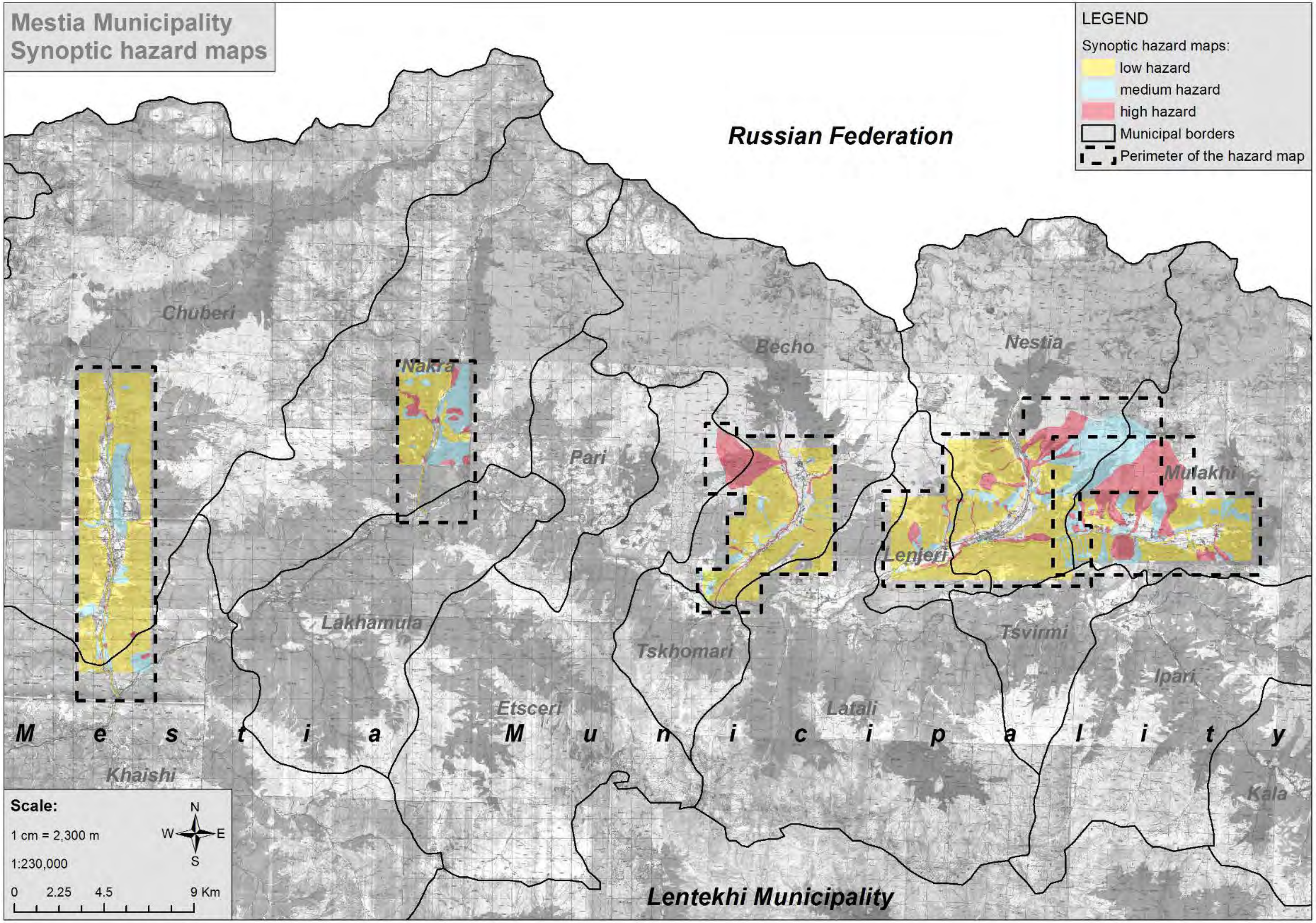
[6] http://www.bafu.admin.ch/naturgefahren/14186/14801/16419/index.html?lang=de



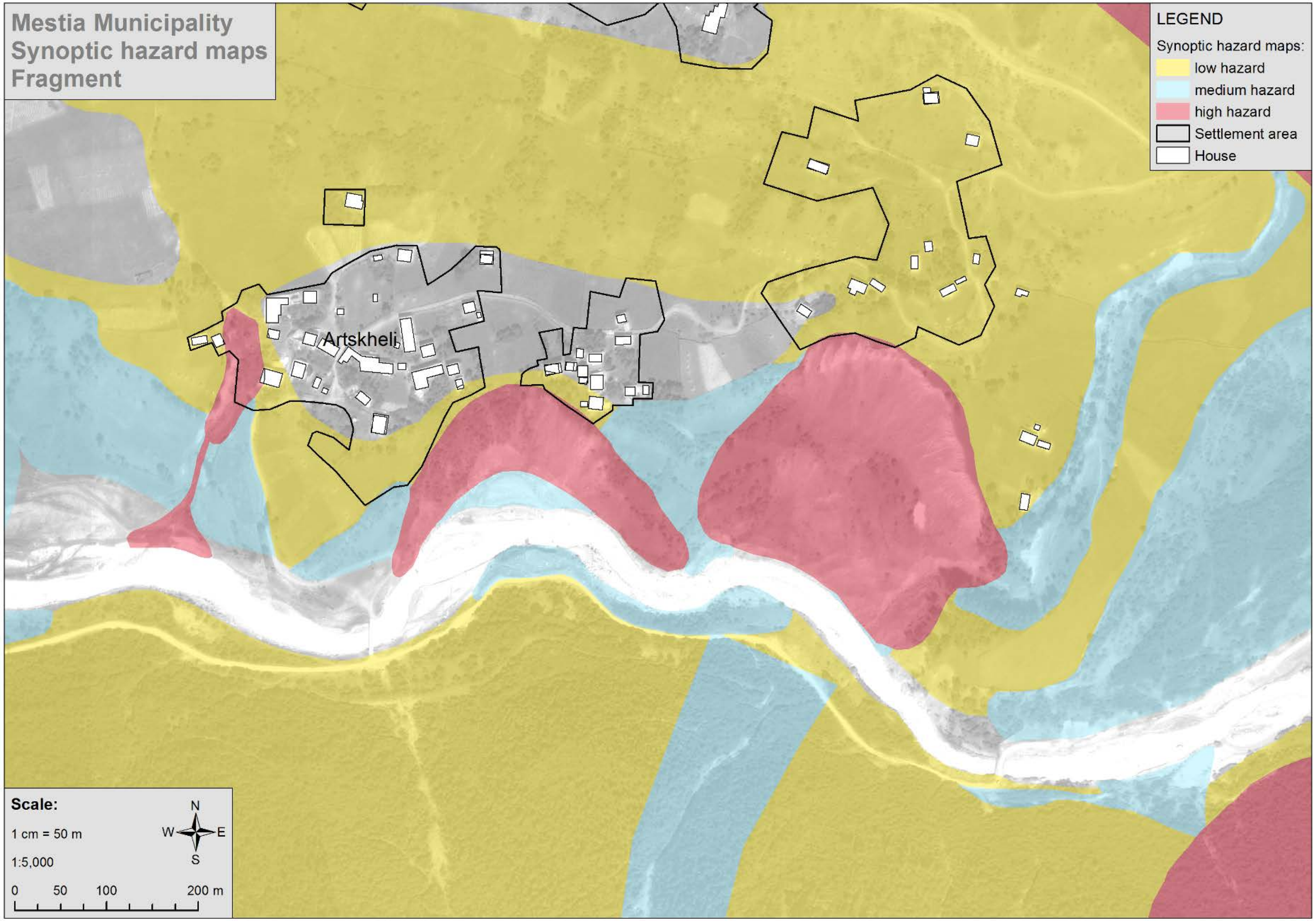
Sample events map for 3 processes, demonstrating availability of NEA data (to each event point is related a descriptive inventory sheet).



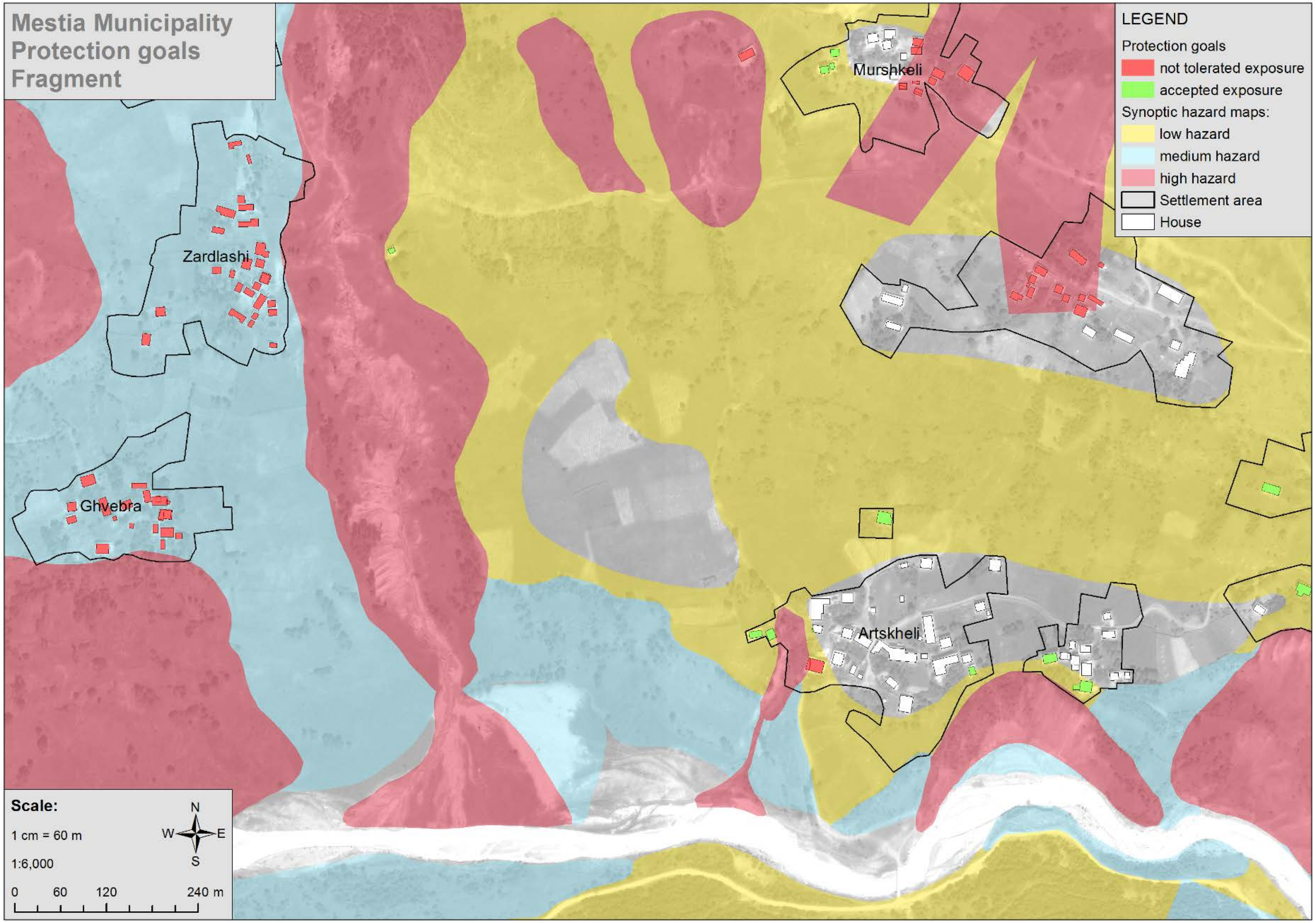
Production of the synoptic map from NEA data for 4 processes. This map is value added to individual data produced by NEA.



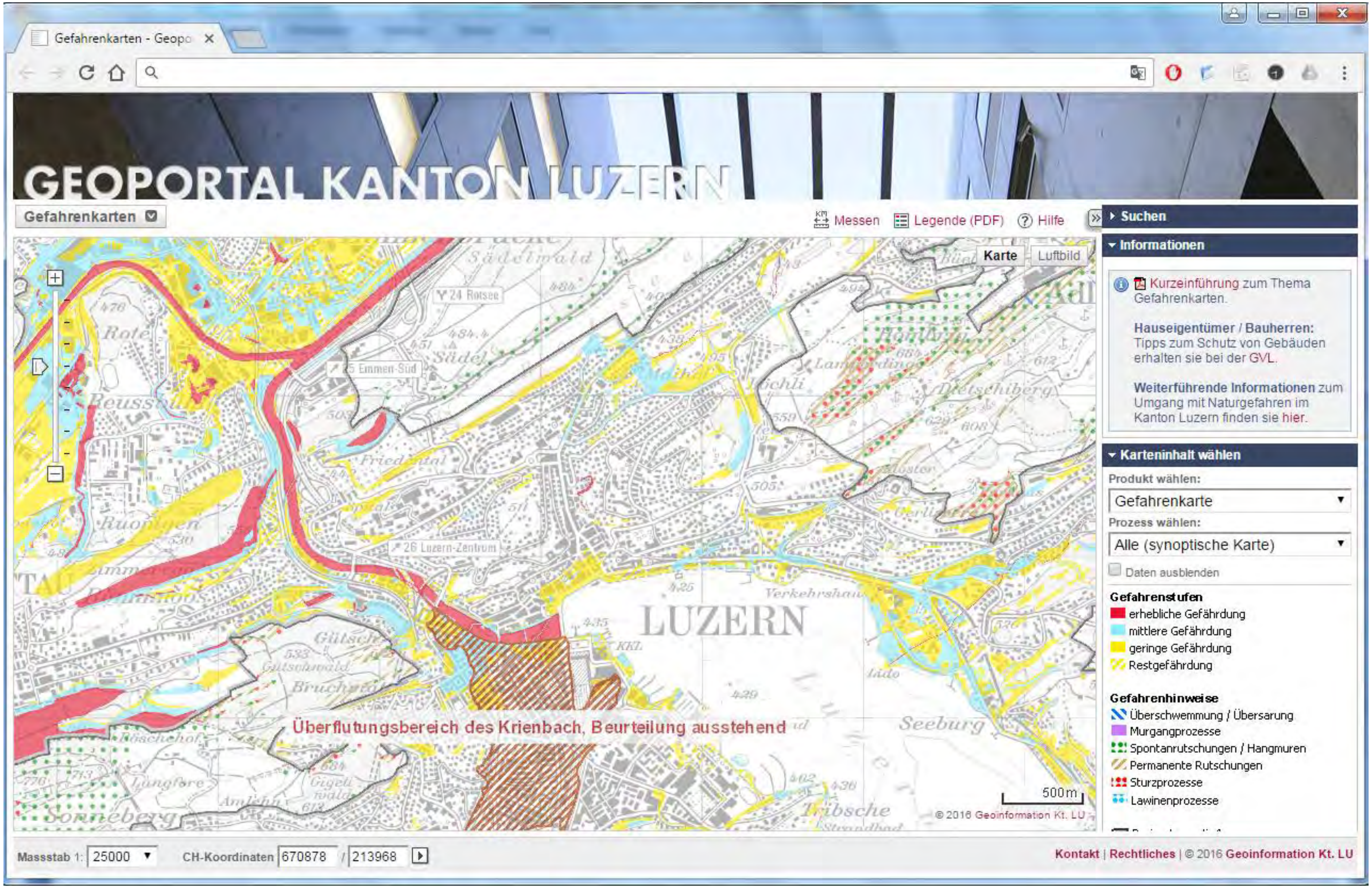
Synoptic maps for all communities of Svaneti for which NEA produced hazard maps (but did not try synoptic result).



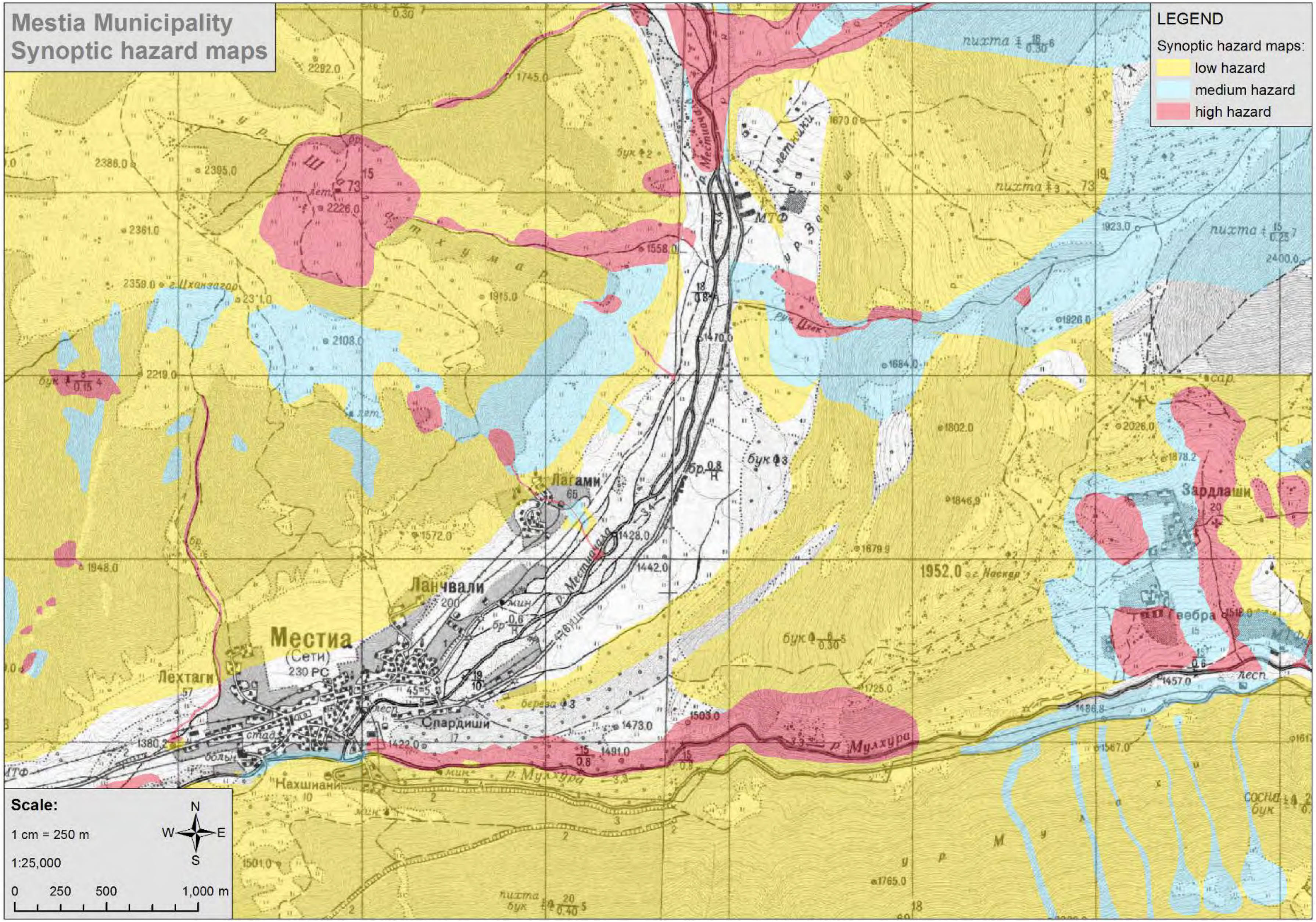
Zooming into mapping scale recommended by Swiss guidelines (1:5,000 scale)



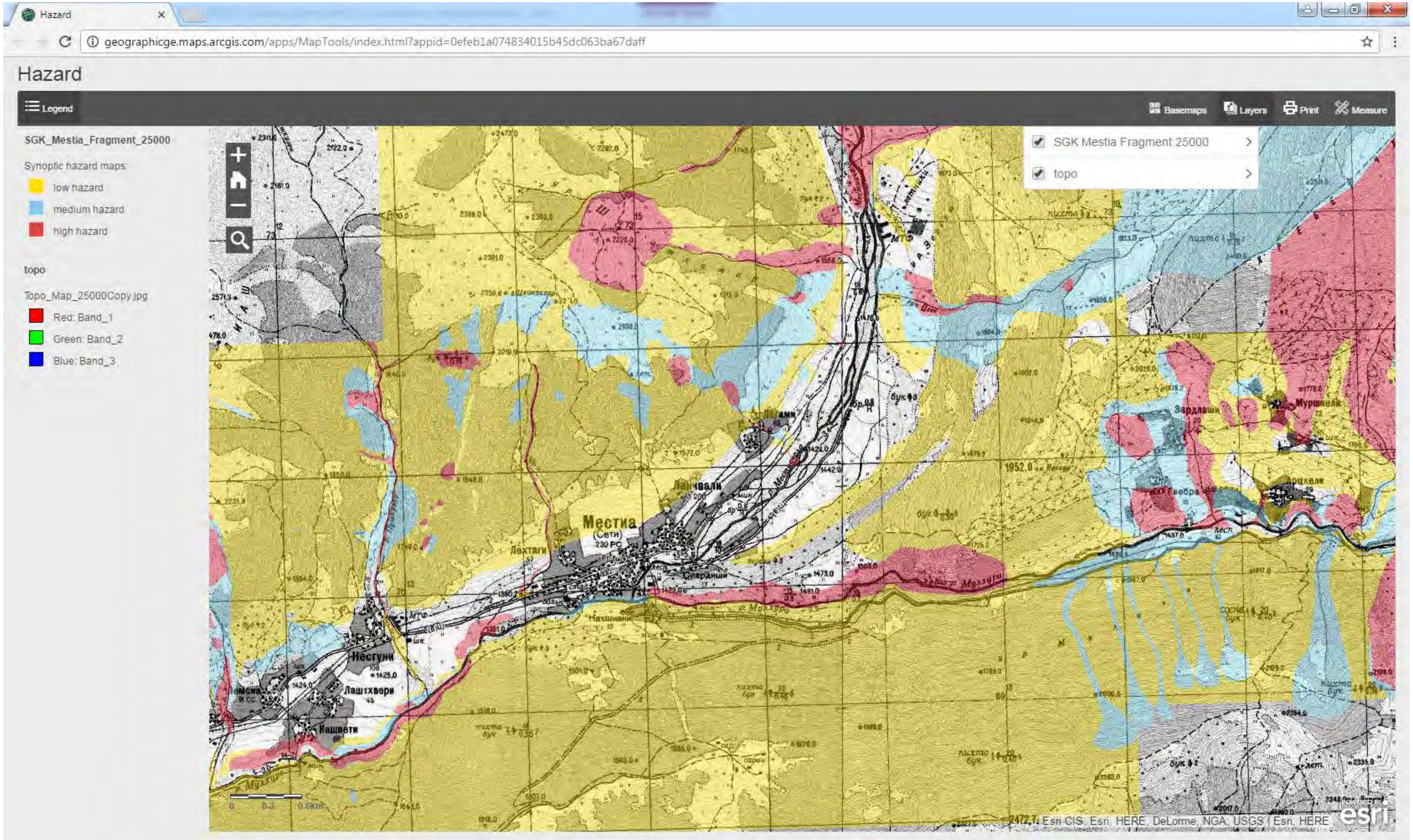
Same scale map demonstrating feasibility of no impact (white) / tolerated (green) / non-tolerated (red) exposure (value added map for NEA).



Screenshot of Swiss hazard mapping geoportal http://www.geo.lu.ch/map/gefahrenkarte for comparison with Georgian data layout.



Synoptic hazard maps compiled in ArcGIS for Becho area. Results seems quite ‘compatible’ with Swiss portal layout at 1:25,000 scale.



Screenshot off-line sample of web-GIS pilot portal demonstrating synoptic hazard map overlaid over b&w topographic map (zoom at 1:25,000 scale).

Considerations on HazMap planning unit extent

Size of the Switzerland is quite comparable to Georgia (both are small countries, albeit Georgia's land area is approx. 4.5 times larger) and both are characterised by quite similar mountain dominated topography. Critical difference is that Switzerland is land-locked country, while Georgia has access to the Black Sea coast and relevant coastal hazards are present as well, such as coastal erosion, which needs to be taken into account when building the hazard mapping system. With this important exception, Swiss system is readily transferable to Georgia from methodological standpoint. Important aspect is the spatial extent of the hazard mapping arrangements, which is considered further below.

Specifically, there are 26 Cantons and 2,596 Gemeinde (municipalities) in Switzerland, which means approximately 100 Gemeindes per Canton. In terms of Hazard Mapping, e.g. in Luzern Canton hazard planning and mapping are performed at the Gemeinde/Municipality level.

Care should be taken though to make terminology distinction between Georgian and Swiss Municipalities. Georgian Municipalities are 76, including self-governing cities (12 such municipalities) and self-governing communities (64 such municipalities) and these are roughly the analogous to Swiss Canton (26 of them), which is the similar size taking into account the 4.5 factor in total national land area. Therefore Swiss municipalities (Gemeindes) are of much smaller size than Georgian municipalities. Equivalent to Gemeinde in Georgia are Administrative Units under each Georgian Municipality.

From the practical standpoint, though, it is suggested to plan for Hazard Mapping at Municipal level in Georgia (equivalent in size to Cantons), as there would be lack of administrative capacity to address such planning at Administrative Unit level, subordinated to Municipalities (see municipal registry at http://mreg.reestri.gov.ge).

On the other hand, all other scales in technical terms applied in Switzerland are applicable to Georgia as well (e.g. 1:5,000 for zoom in mapping and zoom out threshold of 1:25,000 for Web-GIS visualisation). Therefore, all the technical HazMap guidelines of Switzerland are again conveniently transferable to Georgia, as these are technical issues independent from particular administrative subdivision of the country.

8. Legal/Institutional (Current)

This and next parts of the report are contributed by legal experts engaged by GeoGraphic to strengthen the depth and breadth of the required legal analysis. These two subsequent sections follow ToR requirements and after the analysis of relevant legal and institutional arrangements for Georgia and issues identified in the course of this analysis, recommendations are generated on best pathways of transposition of Swiss HazMap methodology and regulations into Georgian reality. This analysis incorporates as well the technical conclusions reached by GIS analysis team when analysing Swiss methodology and its application in Georgia. Conclusions drawn therefore are reflective not only of the legal and institutional, but also the technical considerations, so that proposed next steps are technically feasible, as well as appropriate and realistic in terms of proposed legal and institutional arrangements.

8.1. Purpose of the analysis

The analysis aims at creating the map of natural disaster hazards, which will highlight the zones facing the hazard of floods, landslides, avalanches and other natural calamities.

8.2. Legal part of the analysis covers:

Scrutiny of the existing legal framework concerning hazard maps; drafting of legislative proposals and recommendations to establish the efficient mechanism which will ensure the creation and maintenance of the maps highlighting hazards on the one hand and on the other - their mandatory use by all the respective governmental authorities when making relevant decisions.

8.3. Law in force of Georgia about the matter concerned

The Law in force of Georgia concerning hazard maps includes both international acts and domestic regulations in terms of laws and sublegal acts.

8.3.1. International Acts

The matter in question is covered by the *Association Agreement between the European Union and the European Atomic Energy Community and their Member States of the one part, and Georgia, of the other part* (Articles 301 and 302). According to Article 301 of the Association Agreement:

The Parties shall develop and strengthen their cooperation on environmental issues, thereby contributing to the long-term objective of sustainable development and greening the economy. It is expected that enhanced environment protection will bring benefits to citizens and businesses in Georgia and in the EU, including through improved public health, preserved natural resources, increased economic and environmental efficiency, as well as use of modern, cleaner technologies contributing to more sustainable production patterns. Cooperation shall be conducted considering the interests of the Parties on the basis of equality and mutual benefit, as well as taking into account the interdependence existing between the Parties in the field of environment protection, and multilateral agreements in the field.

According to Article 302 of the Association Agreement:

Cooperation shall aim at preserving, protecting, improving and rehabilitating the quality of the environment, protecting human health, sustainable utilization of natural resources and promoting measures at international level to deal with regional or global environmental problems, including in the areas of:

a) environmental governance and horizontal issues, including strategic planning, environmental impact assessment and strategic environmental assessment, education and training, monitoring and environmental information systems, inspection and enforcement, environmental liability, combating environmental crime, transboundary cooperation, public access to environmental information, decision-making processes and effective administrative and judicial review procedures;

b) air quality;

c) water quality and resource management, including flood risk management, water scarcity and droughts as well as marine environment;

With a view to implementation of the Association Agreement Decree #59 of the Government of Georgia was adopted on January 26, 2015 *On Approval of the National Action Plan of 2015 for the Implementation of the Association Agreement between the European Union and the European Atomic Energy Community and their Member States of the one part, and Georgia, of the other part and Association Agenda between Georgia and the European Union,* which Decree serves the purposes of fulfilment of international commitments. Article 384[3] of this Plan provides for the following commitment:

Development of consistent method of collection of environmental data for various ministries, within the framework of Shared Environmental Information System (SEIS) and accessibility of environmental information for the society at large (Association Agenda: 2.6 Other Cooperation Policies; Environment and Climate Change) - authorised body - Ministry of Environmental Protection).

Also adopted is the Decree of the Government of Georgia #382 of March 7, 2016 *On Approval of the National Action Plan of 2016 for the Implementation of the Association Agreement between the European Union and the European Atomic Energy Community and their Member States of the one part, and Georgia, of the other part and Association Agenda between Georgia and the European Union,* which Decree also serves the purposes of fulfilment of international commitments. Amongst them, in the environmental field the Action Plan includes the provisions about National Environmental Action Program (NEAP) and Third National Environmental Action Program (NEAP-3)

Georgia's commitments under the Association Agreement and domestic legal acts adopted for the implementation thereof prove, that not only the domestic legislation obliges the state to monitor the environment and then create relevant databases, but the same obligation is imposed by the international agreements and timely implementation of this matter should be regarded as one of the first priorities.

8.3.2. Domestic Acts

The following laws and secondary regulation concern the matter in question:

- Local Self-Governance Code (2014);
- Law of Georgia on Structure, Powers and Operational Procedure of the Government of Georgia (2004);
- Law of Georgia on Basic Principles of Spatial Arrangement and City Planning (2005);
- Law of Georgia on Civil Security (2014);
- Law of Georgia on the Procedure of Planning and Coordination of National Security (2015);
- Resolution #508 of the Government of Georgia On Approval of Civil Security National Plan, dated September 24, 2015;
- Resolution #262 of the Government of Georgia, dated October 9, 2013 on Setting up the Governmental Commission for Establishing and Development of Spatial Data Infrastructure
- Order #27 of the Minister of Environment and Natural Resources Protection of Georgia on Approval of the Regulations of the Legal Entity of Public Law - National Environmental Agency, dated May 10, 2013.

Applicable Legal Acts

International Commitments	Implementation of International Commitments	Domestic Acts
Association Agreement between the European Union and the European Atomic Energy Community and their Member States of the one part, and Georgia, of the other part entered into force on July 1, 2016	1. Resolution #262 of the Government of Georgia, dated October 9, 2013 on Setting up the Governmental Commission for the Creation and Development of Spatial Data Infrastructure 2. National Action Plan for the Implementation of the **Association Agenda** between Georgia and the European Union (approved annually by a governmental decree)	-1. Local Self-Governance Code (2014); -2. Law of Georgia on Structure, Powers and Operational Procedure of the Government of Georgia (2004); -3. Law of Georgia on Basic Principles of Spatial Arrangement and City Planning (2005); -4. Law of Georgia on Civil Security (2014); -5. Law of Georgia on the Procedure of Planning and Coordination of National Security (2015); -6. Resolution #508 of the Government of Georgia On Approval of Civil Security National Plan, dated September 24, 2015; -7. Order #27 of the Minister of Environment and Natural Resources Protection of Georgia on Approval of the Regulations of the Legal Entity of Public Law - National Environmental Agency, dated May 10, 2013

8.4. Georgian Legal Framework on Emergency Risk Map

According to Law of Georgia on Civil Security an emergency situation means "such critical situation on a specific territory or is an organization, which is characterised by disturbance of normal living conditions of population caused by a disaster, massive industrial accident, fire, **natural calamity**, epidemics, epizooties, epiphytotics or through using ammunition and which **endangers or/and may endanger the life or/and health of population**, causes or may cause casualties, human injury or/and material damage." (Article 5.2)

According to Law of Georgia on Structure, Powers and Operational Procedure of the Government of Georgia (2004) the following falls within the terms of reference of the Government: *setting key tasks, duties and operational procedures for the executive authorities with a view to prevention of emergencies or reaction thereto; (Article 20 b.)* Pursuant to the same Law *prevention of emergencies means a set of legal, organizational, economic, engineering-technical, sanitary-hygienic, sanitary-epidemiological and other measures carried out for the protection of the population, property and environment, which set of measures includes: d)* ***preparation of emergency risk map****, division of the territory of Georgia and cities into groups and organizations according to categories; (Article 28.2b).*

This stipulation of law means that the risk map is a set of interdisciplinary databases, which embodies all predictable risks (industrial risks, natural calamities, spread of epidemics, etc.), what may cause an emergency situation. Map of natural disaster hazards is an integral part of emergency risk map.

Insofar as preparation of emergency risk map is one of the instruments of prevention and reaction, while setting key tasks, duties and operational procedures for the executive authorities with a view to prevention of emergencies or reaction thereto falls within the terms of reference of the Government; the obligations, related to preparation, maintenance and use of risk map should be defined by the Government of Georgia, by a respective resolution.

8.5. Institutional Arrangement of Prevention and Management of Emergencies in Georgia

Authorization for the prevention and management of emergencies is distributed between various agencies with regard to:

- national security matters;
- civil security matters and
- environmental matters.

8.5.1. National Security

Pursuant to the Law of Georgia *on the Procedure of Planning and Coordination of National Security* one of the fields of national security policy is ecological and energy safety, which includes, but is not limited to:

a) Detection, identification, assessment and prediction of ecological and energy hazards, risks and challenges;

b) Ensuring the compatibility of the utilization of natural resources with the purposes and goals of national security;

c) Development of respective mechanisms for the protection of population and territory against natural and industrial emergencies;[7]

According to the same Law the nation-wide conceptual documents are:

a) National security concept;

b) Georgia's risk assessment paper;

c) National strategies in security field.

[7] Law of Georgia on the Procedure of Planning and Coordination of National Safety, Article 10.

Under this Law the *State Security and Crisis Management Council* was set up, which acquaints itself with information about the situation in state security and law-and-order fields, analyses it, identifies internal and external hazards, assesses them and develops the necessary measures for the prevention of these hazards. The Council is the deliberative body to Prime-Minister and is subordinated solely thereto.

Local natural calamities should not be regard as matters of national security as they do not constitute hazards of that scale, to jeopardize national security. Respectively, the creation of this segment of emergency risk map falls within the terms of reference of the aforementioned Council either.

8.5.2. Civil Security

One of the main purposes of the Law of Georgia on Civil Security is the identification of procedures for fire prevention, putting-out and organization of emergency and rescue operations, provision for the **prevention of emergencies, reaction thereto**, mitigation and liquidation of their consequences. According to Article 28.2 (d) of the mentioned Law *prevention of an emergency situation means a set of legal, organizational, economic, engineering-technical, sanitary-hygienic, sanitary-epidemiological and other measures carried out for the protection of the population property and environment, which set of measures includes, amongst them,* ***preparation of emergency risk map****, division of the territory of Georgia and cities into groups and organizations according to categories.*

According to this Law the specially authorized body is the Legal Entity of Public Law - Emergency Management Agency (EMA) operating within the framework of the Ministry of Internal Affairs of Georgia. EMA ensures the prevention of an emergency, readiness of shared system, reaction to an emergency and organization of restoration operations within emergency zone and implementation of Civil Security National Plan for the settlement of civil security tasks. However, along with specially authorized body there exists the unified system for the prevention and management of emergencies pursuant to the Law, the subjects of which system have obligations concurrent with their specific powers.

Under Resolution #506 of the Government of Georgia of September 24, 2014 *on Approval of Civil Security National Plan* EMA was assigned to ensure the carrying out of measures related to the implementation of Civil Security National Plan approved by the Resolution concerned[8]. The Resolution designated MEA as specially authorized body for the management of risks.

Under the Resolution one of the preventive measures is *the preparation of emergency risk map and streamlined dislocation of industrial units and settlements on the territory of the country with due consideration of these maps, pursuant to land-use normative regulations*[9]. The Ministry of Economy and Sustainable Development of Georgia and the Ministry of Justice of Georgia were assigned to participate in the preparation of risk map[10].

It should be mentioned, that the participation of the Ministry of Environment and Natural Resources Protection of Georgia and National Environmental Agency is not provided for either by the Law on Civil Security or the Governmental Resolution on Approval of Civil Security National Plan.

8.5.3. Environmental Protection

Regulations of the Public Law Legal Entity - National Environmental Agency (NEA) was approved by Order # 27 of the Minister of Environment and Natural Resources Protection of Georgia, dated May 10, 2013. The Regulations provides for the list of NEA goals, tasks, duties and rights and obligations, amongst them:

- *Procession of environmental observation data, assessment of the environmental status and dissemination of respective informational products;*

[8] Resolution # 508, Article 2.

[9] Resolution # 508 Article 9.5(b.b).

[10] Resolution # 508 Article 9.12 (c.d).

- Drafting short-, medium- and long-term forecasts about hydro-meteorological and geological conditions and qualitative status of the environment, warnings about potential natural calamities, and extremely high pollution of the environment, provision of information to local authorities and mass media;[11]

Although NEA Regulations does not directly provide, that NEA participates in the preparation of emergency risk map or creates maps regarding matters falling with its terms of reference independently from this map, however, owing to general duties and obligations of NEA it is apparent that it has the obligation to reflect the outcomes of environmental observation, survey of potential natural calamities in digital database, what can be done in terms of a map as well.

8.6. Obligation to impose Requirements of the European Parliament Directive №2007/2/EC of March 14, 2007

Under the Resolution #262 of the Government of Georgia of October 9, 2013 the Governmental Commission was set up for Establishing and Development of National Spatial Data Infrastructure in Georgia. *The Commission was set up with a view to establishing and development of infrastructure for national spatial data, drafting of national standards for collection, storage, updating and sharing of spatial data and metadata, also data format, digital information, identification of strategic goals, tasks and priorities of nation-wide geo-informational policy of the country.*[12]

Duties and tasks of the Commission are as follows:[13]

a) Drafting of proposals and recommendations with a view to determination of common policy of the Government of Georgia in the field of establishing and development of infrastructure for national spatial data and improvement of state system of management of related thereto processes;

b) Drafting of relevant proposals with regard to measures to be carried out in the field of establishing and development of infrastructure for national spatial data based on the European Parliament Directive №2007/2/EC (INSPIRE) of March 14, 2007 Establishing an Infrastructure for Spatial Information in the European Community;

c) Drafting of proposals for establishing infrastructure for national spatial data compatible with the European standards;

d) Supervision over the elaboration of the concept of infrastructure for national spatial data and its compatibility with the European standards;

e) Coordination of and supervision over the work/measures undertaken in the country with a view to establishing and development of infrastructure for national spatial data, drafting of national standards for collection, storage, updating and sharing of spatial data and metadata, also data format, digital information, identification of strategic goals, tasks and priorities of nation-wide geo-informational policy of the country;

f) Identification of needs to be reflected in the infrastructure for national spatial data.

Based on the goals and duties, provided for by the Regulations, it can be said, that the Commission has supervisory duty and actually, it has to confirm the compatibility of the document, drafted by the authorised for the creation of the map body with INSPIRE standards.

8.7. Summary

Based on the foregoing it can be said, that according to the law the authority to prepare emergency risk maps is delegated upon the LEPL Emergency Management Agency. However, there are certain overlapping between the powers of the EMA and NEA. Specifically, the authority to create a map of natural disaster hazards stems from NEA Regulations. Although NEA Regulations does not provide for the obligation to create the mentioned map, the existence of the obligation to identify natural calamities, statistic observation, creation of databases, and early warning implies the creation and maintenance of a similar-purpose map or other systemized databases. As a result, there definitely is the partial overlapping of the powers of various state authorities in the field concerned. Additionally, if the risk of natural calamities is so high, that it jeopardises national security, it falls within the terms of reference of the State Security and Crisis Management Council.

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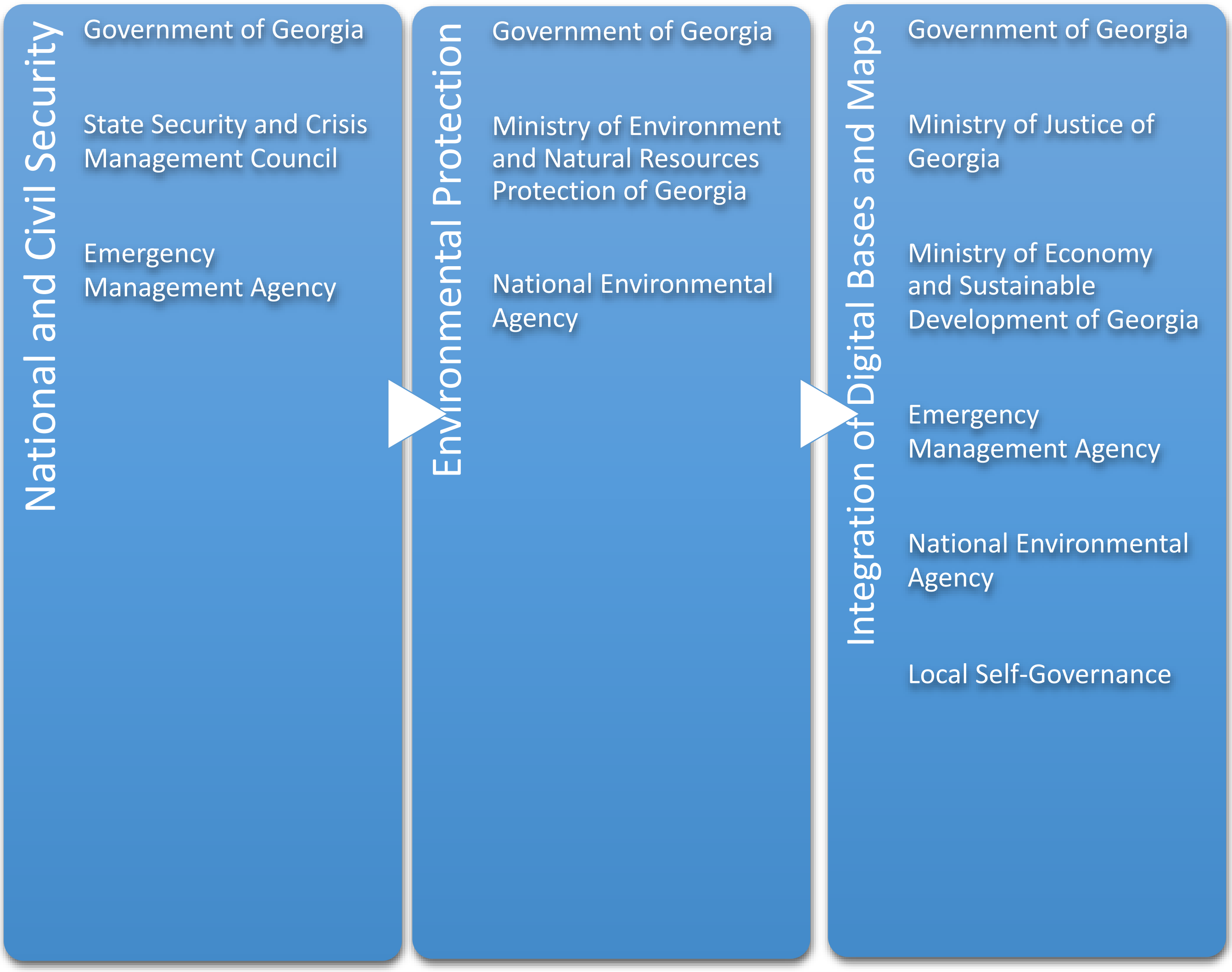
[11] Order #27, Article 2.

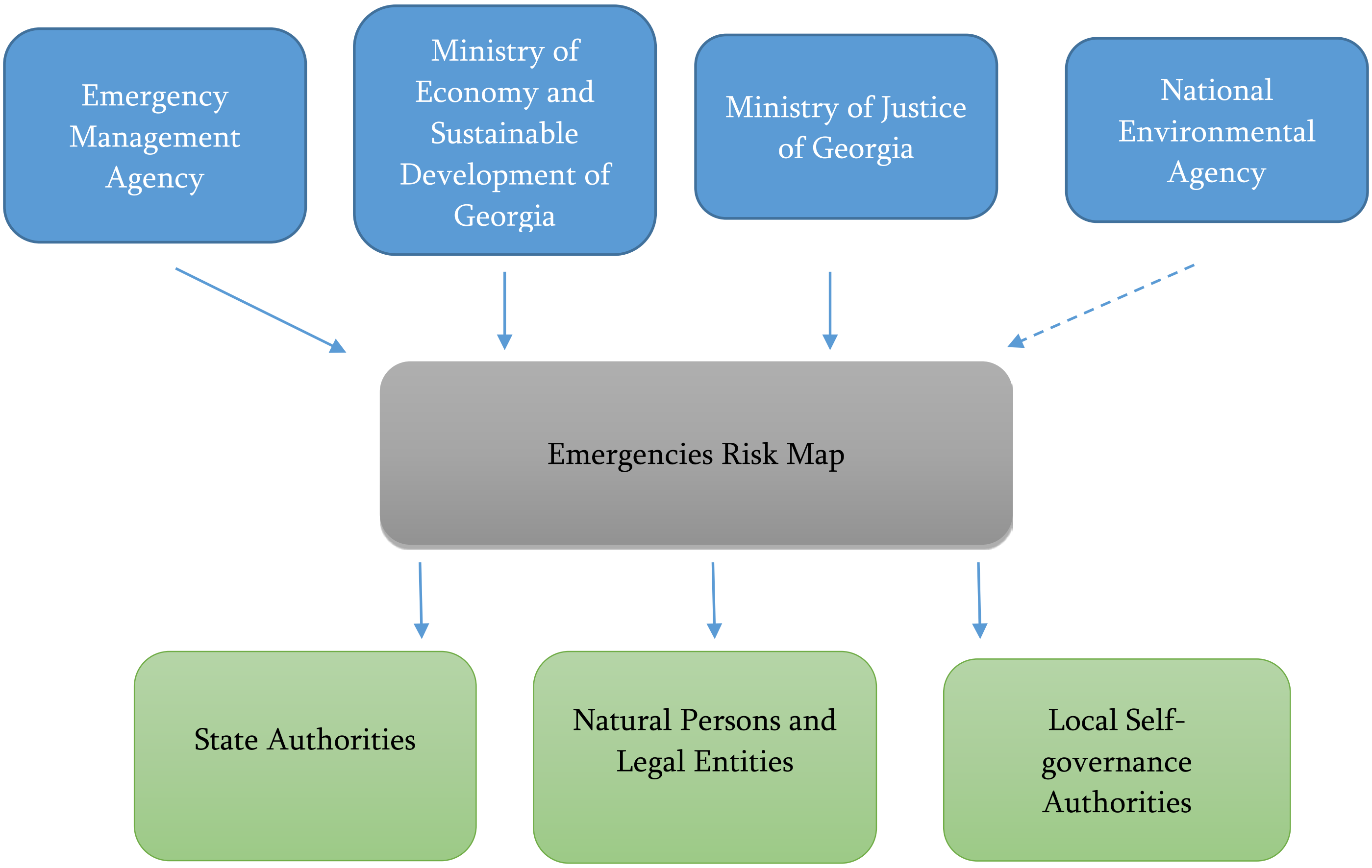
[12] Commission Regulations, Article 2.1.

[13] Commission Regulations, Article 3 (g).

Authorized Governmental Authorities



Persons Participating in the Creation
of Map and Map Users
Current Model



9. Legal/Institutional (Recommendations)

9.1. Recommendations

The analysis aims at the creation of the map which will highlight the zones with various levels of hazard of flood, avalanche and landslide. It is possible later to add layers highlighting other natural calamities as well. As a results, civil security, public health and life of the population will be better protected, the development of settlements and infrastructural objects will become safer. To this end it is necessary to create flexible and interactive mechanism, that will promote continuous updating of the map, involvement of qualified persons in this process, accessibility of data the map is consisting of.

Insofar as the National Environmental Agency is the body within the terms of reference of which already falls the examination of natural calamities, conduct of respective observations and surveys, creation of early warning system, insofar as NEA has historical data about natural calamities and the reasons causing them, it will be reasonable for NEA to be designated as the responsible authority for the maintenance of one of the parts of risk map - map of natural disaster hazards, while the common standard of the map should be defined by a Governmental resolution. Below are listed normative acts to be adopted to this end or to be amended:

a) Resolution #506 of the Government of Georgia of September 24, 2014 on Approval of the National Plan on Civil Security

According to this Resolution the obligation to participate in the preparation of the risk map is vested with the Ministry of Economy and Sustainable Development of Georgia and the Ministry of Justice of Georgia, whilst the body specially authorized for the prevention and management of emergencies is the Emergencies Management Agency of the Ministry of Internal Affairs of Georgia. By an amendment to be made to the Resolution NEA should be obligated to take part in the preparation of emergency risk map and is should as well be specified, that the agency concerned is responsible for the preparation of one of the parts of emergency risk map - map of natural disaster hazards and this very agency should be obligated to transfer maps, prepared thereby to Emergencies Management Agency of the Ministry of Internal Affairs of Georgia.

As a result of these amendments NEA will become the body responsible for the preparation of map of natural disaster hazards and maintenance of respective databases. Emergencies Management Agency of the Ministry of Internal Affairs of Georgia will retain the duty of preparation and combining of the map of natural disaster hazards risk map while the Ministry of Economy and Sustainable Development of Georgia and the Ministry of Justice of Georgia will still participate in the participation of the map, within their competence.

b) NEA Regulations

Although NEA is entitled to *draft warnings about potential natural calamities, and extremely high pollution of the environment, update data pools about hydro-meteorological and geological conditions and qualitative status of the environment and form databases using modern technologies*, for clarity and avoidance of multiple interpretation it should be directly stated in the Regulations that NEA prepares and maintains the map of natural disaster hazards and makes it available for every interested person, which can be user of the map.

c) Resolution #59 of the Government of Georgia on Basic Provisions of Regulation of the Use and Development of the Territories of the Settlements, adopted on January 15, 2014

One of the goal of preparation of the map of natural disaster hazards is to restrict inadmissible development in high risk areas. For this purpose the addendum shall be made to Resolution #59 of the Government of Georgia on Basic Provisions of Regulation of the Use and Development of the Territories of the Settlements, adopted on January 15, 2014. Certain restrictions shall be imposed with regard to construction and development of the territory identified as a high-risk zone according to the map of natural disaster hazards. It will be desirable for the area falling within the boundaries identified as a high-risk zone to be granted with different status of functional zoning; also, these zones are to be included into land-use master plans in order to create an integrated system, what will simplify the process of establishment of city development conditions and will minimize the probability of issuing permits for the erection of inadmissible facilities in risk zones. Upon scrutiny of the territories in the light of risk, it may presumably become necessary to subdivide risk zones into sub-zones according to the extent and level of hazard and different city development conditions to be provided for each zone. In technical regulation the new zones, reflecting hazard zone may be regarded as one of the subzones of special purpose zone envisaged by the Law of Georgia on Spatial Arrangement and Basic Principles of City Planning or it is possible for an addition to be made to the Law concerned and natural calamities hazard zones to be added to the list of development zones (see below the visual example - two sample maps).

d) Tbilisi Municipality Assembly Resolution #24-39 of May 24, 2016

Insofar as setting city development conditions and use of the territories of Tbilisi Municipality is regulated by Resolution #24-39 of Tbilisi Municipality Assembly on Approval of the Rules of Use and Development of the Territories of Tbilisi Municipality adopted on May 24, 2016, the amendment, mentioned in the previous paragraph should be made to the Resolution concerned as well. Corresponding provisions shall be included to the regulations on city development conditions and use of the territories adopted or to be adopted by other municipalities as well.

e) Resolution #57 of the Government of Georgia on the Procedure of Issuance of Construction Permits and Permit Conditions of March 3, 2009

Corresponding amendment should be made to Resolution #57 of the Government of Georgia on the Procedure of Issuance of Construction Permits and Permit Conditions and zones granted to the territories covered by map of natural disaster hazards should be added to relevant zoning.

Submission of relevant conclusion by an applicant should become the mandatory precondition for the issuance of a construction permit in high risk zones, covered by the map concerned.

With a view to improvement of the information reflected on the map, risk prevention and its further management the authorities competent for the issuance of construction permits of self-governance units, where the electronic databases compatible for map of natural disaster hazards will be prepared, should ensure the uploading to issued construction permits to the map of natural disaster hazards.

f) Procedural Resolution of the Government

Apart from the aforementioned amendments, based on the authority of the Government of Georgia to prevent and manage emergency situations, it is important for the Government of Georgia to adopt a procedural resolution, under which resolution the preparation of map of natural disaster hazards and setting timelines with this regard will be delegated upon NEA. The resolution should provide in details for the accurate characteristics of the map, its format, etc. also its compatibility with №2007/2/EC Directive (INSPIRE) of March 14, 2007. This should be done in cooperation with the Commission for Establishing and Development of National Spatial Data Infrastructure in Georgia.

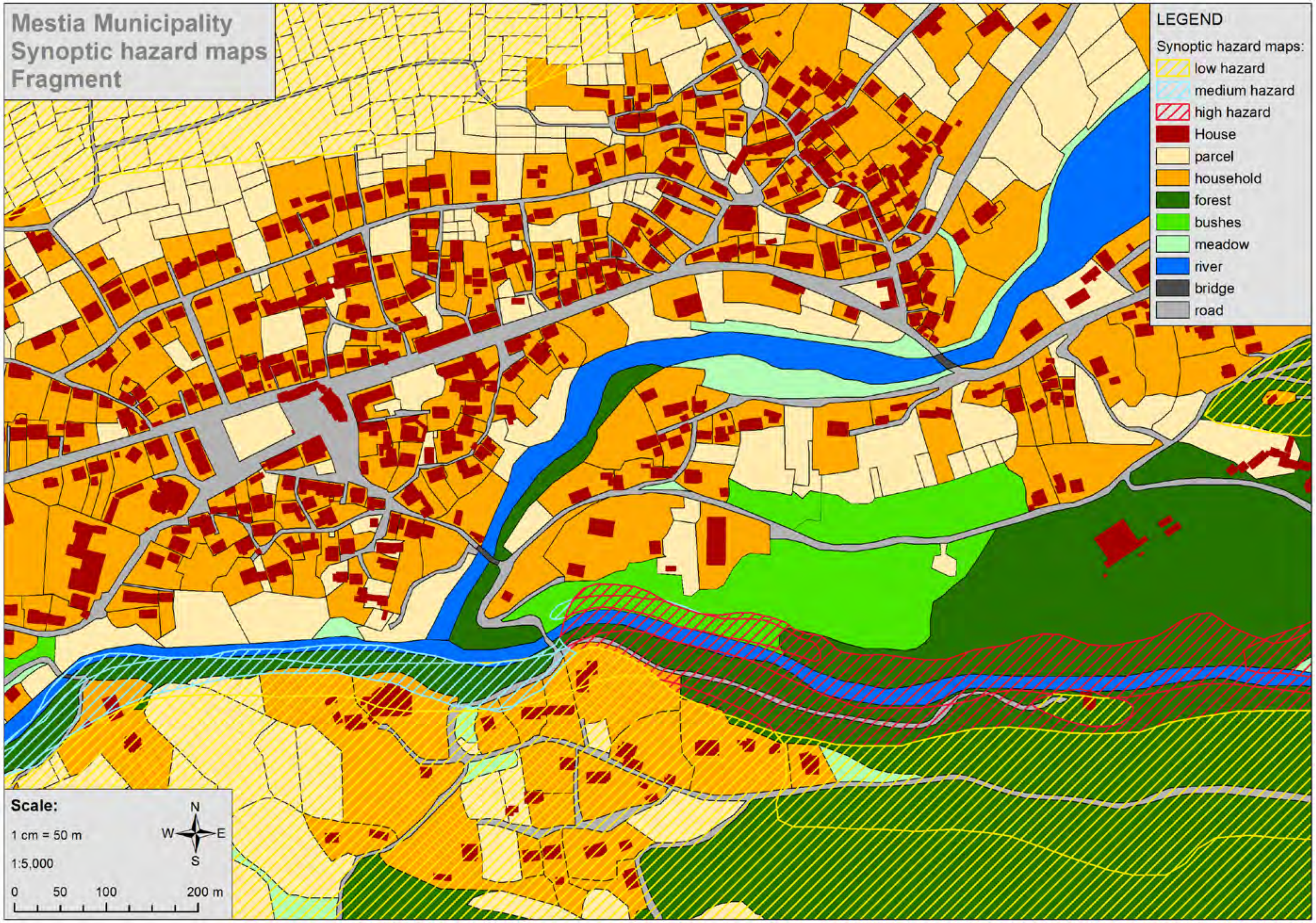
The Ministry of Justice of Georgia should be obligated to provide relevant information to NEA. Although this obligation of the Ministry of Justice of Georgia already defined by the Resolution of the Government of Georgia on Approval of Civil Security National Plan, the mentioned Resolution makes only a general reference to the participation of the Ministry of Justice. Insofar as the Ministry of Justice is the only authority, which creates and manages the cadastral databases, and for the prevention of construction or development of settlements and infrastructure in natural calamity zones, the Ministry of Justice should provide the authority responsible for the creation of the map, with the available information free of charge.

The Resolution should specify, that the map of natural disaster hazards is accessible for every interesting person.

The Government may decide to prepare map of natural disaster hazards for the settlements of high-mountain regions and river beds as priority. This decision will minimise inadmissible development in high-risk zones.

The resolution may also provide, that local self-governance authorities, as well as other interested persons, may be allowed to develop specific segments of the map of natural disaster hazards on condition, that the electronic database, developed thereby will meet the standard set by the Governmental Resolution, will be based on NEA data, will be provided to NEA free of charge and will be integrated into NEA database.

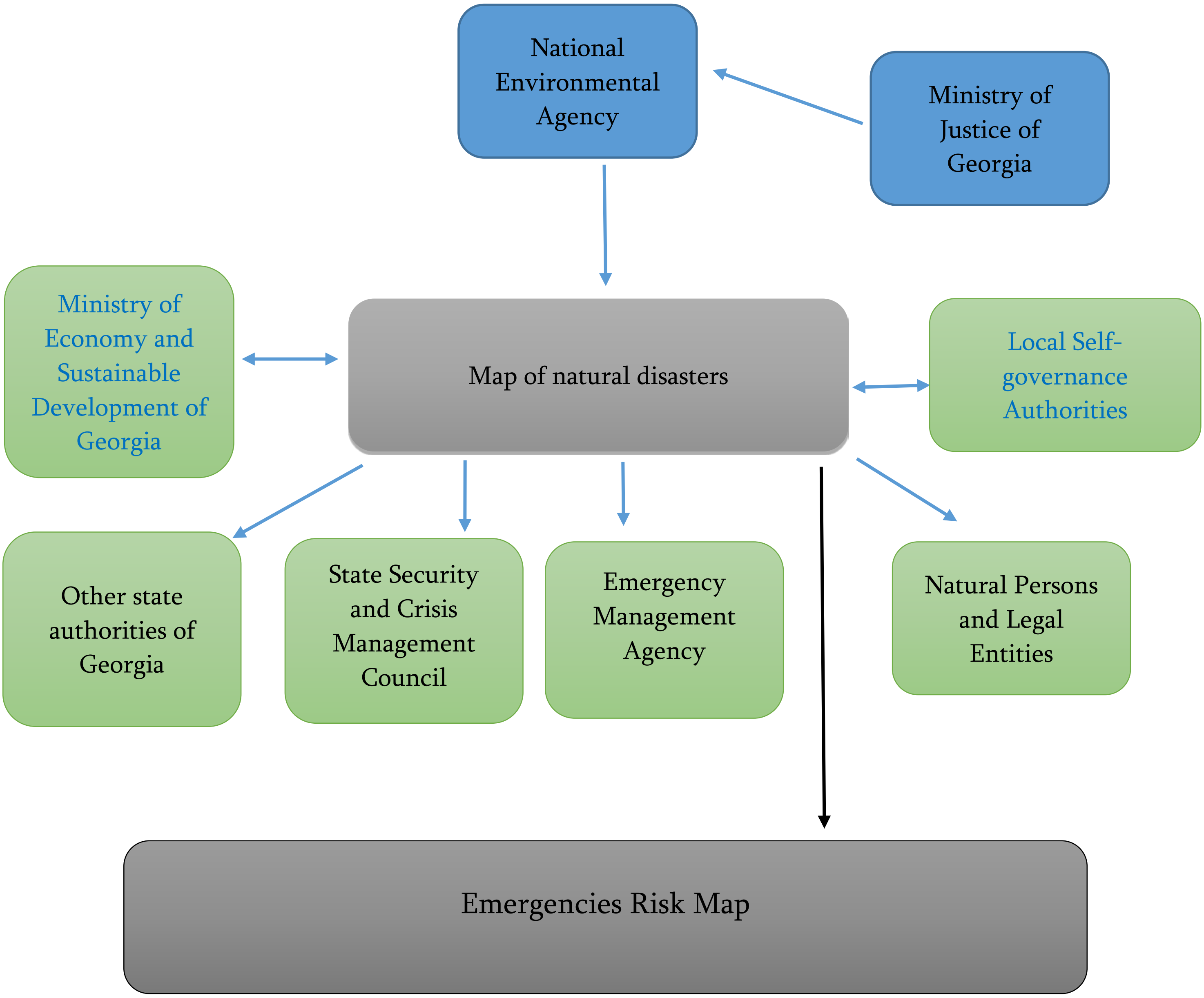
Sample map in typical natural hazard mapping legend symbology.



The same sample integrated into the typical spatial planning legend symbology.

Persons Participating in the Creation of Natural Calamity Hazard Maps and Map Users

Recommended Model



10. Consultations

Certain consultations were held during this initial phase of the analysis. Aim of these consultations were to familiarise with the work done and to sensitize beneficiaries with project objectives as well as to address work planning as well. After completion of the initial process and gap analysis, in-depth consultations were held with NEA leadership including personally the NEA Chairperson as well as all involved technical departments personnel concerned. Such initial consultations are reported in the methodology sub-section of this report. Importantly, the next sub-section presents certain considerations of NEA with specific emphasis of flooding hazard, which can be considered as a standalone issue (with more detailed treatment needs) as well as in the context of the integrative hazard mapping at the national and local community levels. This part constitutes important contribution of NEA into this report, demonstrating NEA expertise and ownership with hazard mapping instrument.

11. NEA Input

Flood and Avalanche hazard mapping plan (NEA)

Hydrometeorological hazards monitoring and recording in Georgia dates back more than 100 years. In the process of hazard assessment different kinds of methodology, mainly have been used, which is based on empirical researches.

Method of long-term statistical analysis is mostly used in hazard identification, which enables us to depict general background maps. In order to create long scale maps of practical usage which will prevent to inhabit hazardous zones as well as all kinds of industrial and agricultural works.

For the time being, there aren't any standards or legalized norms in assessment of natural hazards/risks, which might help to determine and establish certain methodologies. It's also obligatory to identify scales for each natural disaster, while depicting hazard maps. With regard to defining levels of natural hazards and conferring colour, it's recommended to have 3-4 colours for three or four standardized categories.

After establishing the above standards, similar categories and colours will be used in early warning systems, where certain regions, municipalities will be depicted with colours for the predicting hazards.

In Georgia now have been existed hydrometeorological hazards background (in scale 1:2 000 000) maps, which is based on recorded historical events. Since 2006, In National Environmental Agency, natural hazards assessment (mostly flood/flash-flood hazard assessment) have been implemented in several projects supported by donor organizations and countries. It should be noted, that in each study, different kinds of software and methodologies have been applied to assess hazards and risks. It is worth mentioning that over last years, in frames of the project - "Developing climate resilient Flood and flash flood management practices to protect vulnerable communities of Georgia" has been carried out several exercises: identification of vulnerable districts, hazard assessment, hydrological and hydraulic modelling and risk mapping. The methodology of hazard assessment which has been used during the project implementation is fully appropriate and its satisfying requirements of EU Flood Directive and other EU standards.

Also, EU Flood directive standards has been used in project – "Early flood warning and prevention system targeted specifically at the Kabali and Duruji Rivers", supported by Polish Center for International Aid. The project has covered the significant tributaries of Alazani River.

In order to assess the hydrometeorological hazards and develop risk maps over the territory of Georgia, at the same time to reach the EU standards and to fulfil the obligations of association agreement (EU flood directive must be implemented until 2021), it`s necessary to proceed several activates:

- Creation of action plan, where will be given detailed explanation about hazard mapping methodologies;
- Increase the amount of specialists in Hydrometeorological Department;
- Improvement of computer modelling skills (trainings for hydraulic, hydrological and mass movements dynamics modelling) and establishment of new modelling software;
- For hydrometric and geodetic surveys, the specialists should be equipped with additional instruments, high pass ability cars etc.;
- Involvement of international experts in modelling and risk assessment.

Methodology of flood hazard mapping[14]

When assessing the flood hazard, a first indication can be obtained by looking at how often floods occurred historically and the magnitude of them. These can be mapped as point events, or extents of historical floods can be depicted on a flood extent map. With the advent of remote sensing imagery, flood extents of current (or very recent) floods can easily and accurately be determined. This opens up possibilities to calibrate or validate flood extents simulated by computer models.

To create and implement policy with respect to flood management it is important to have up to date flood information which is consistent over the entire territory. The use of historical flood maps is in this respect restricted since it is impossible to compare them as return periods are not equal and boundary conditions (streambed, land cover, etc.) may have changed significantly over time. To overcome this problem, statistical and modelling tools are used to calculate the hazard of hypothetical floods. There are various parameters that can be used to denote the flood hazard. These include the flood extent, water depth, flow velocity, duration, propagation of water front, and the rate at which the water rises. Water depth is one of the main factors of importance with respect to flood damage. However, in steep upstream areas and next to dike-breach locations flow velocity (and debris content) is a very important factor for flood damage. Furthermore, information on the propagation of the flood wave and the rate at which the water rises is critical for emergency planners in charge of evacuation, and to estimate the potential loss of life.

The calculation of the flood hazard can be done using methods of varying complexity, depending on the amount of data, resources, and time available. While there are different approaches the conceptual framework behind the calculation of flood hazards is quite general and consists broadly of three steps:

1. The first step is to estimate discharges for specific return periods. This can be done by using frequency analyses on discharge records and fitting extreme value distributions. When there is no discharge data available but there are precipitation records, runoff coefficients can be used to deduce discharge information.

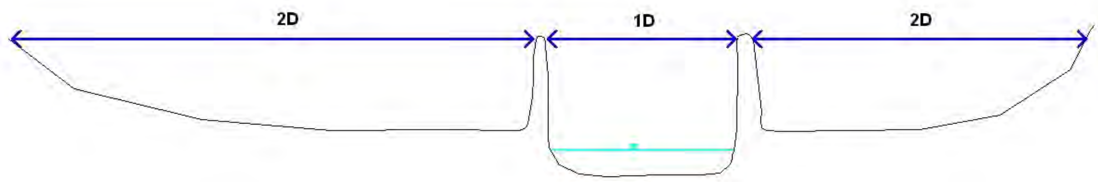
Whether direct discharge measurements or discharge information derived from precipitation records flood maps are used, only a fraction of the basin is usually gauged, whilst for national flood mapping projects information is required for all river stretches. To overcome this, flood information (e.g. discharge, precipitation, or flood moments) can be extrapolated to ungauged parts using regionalization techniques. More often however, hydrological models are used to calculate discharges. Such models come in various complexities, but they all require spatially explicit meteorological (e.g. temperature, precipitation, evaporation, radiation), soil, and land cover data as input. This data can be acquired from datasets of interpolated observed data, from re-analysis datasets (e.g. the ECMWF ERA datasets), or from climate models (e.g. the Hadley and ECHAM models). Spatial hydrological models solve the water balance for each geographical unit (e.g. grid-cell) for each time step and route the runoff downstream, yielding discharges throughout the entire catchment. Such models can additionally be used in scenario analysis, for example in the assessment of the impact of changes in climate or land cover by changing the input meteorological data or land cover scheme.

2. When discharges and their return periods have been derived using the above mentioned approaches, a subsequent step towards developing a flood map is to translate discharges into water levels. This is usually done with rating (stage-discharge) curves. Alternatively, 1- D or 2-D hydrodynamic models can be used to determine water levels. The latter is especially useful in hydraulically complex areas like river confluences or drainage systems that have been heavily modified through human interference. Furthermore, hydrodynamic models allow for considering additional flood parameters, like flow velocity, propagation, duration, and the rate at which the water rises. Some additional information is however required for 2-D hydrodynamic modelling, like flood wave characteristics (duration, peak).

14 http://www.nat-hazards-earth-syst-sci.net/9/289/2009/nhess-9-289-2009.pdf

Modelling approach:

- In the upper catchments main river channels is usually well defined, and velocities are very significant due to the high slope. Therefore, floodplains are not very extensive, and 1D processes dominate in these area. In these areas a 1D model is recommended.
- However, there may be structures in the river channel that may affect the flow, creating scenarios where a 2D approach may be more appropriate. Also, in those areas a 2D approach (or a combination or 1D and 2D approach), maybe more appropriate.
- Also, once the flood mapping has been carried out, during the optioneering process, it may be required to have some of the models in 2D in order to fully assess the proposed options.
- In the lower catchment, a 1D-2D approach is initially recommended. This is especially due to the very low gradients and to the existing embankments at either side of the river channel. As previously noted, once the flow escapes from the river channel, 2D processes will dominate. This means that the river channel up to the top of the embankments will be modelled in 1D and the floodplain will be modelled in 2D.



3. In the third step the flooded area (and possibly flood depth) is determined by combining water levels with a digital elevation model (DEM), thus creating a flood map showing flood extent or depth. A DEM is already included in 2-D hydrodynamic models, in which case this third step is already addressed.

Flood map types

Flood extent maps
The most common flood hazard maps are flood extent maps. These are maps displaying the inundated areas of a specific event. This can be a historical event, but also a hypothetical event with a specific return period (e.g. once every 100 years, often expressed as HQ100). The extent of a single flood event, or of multiple events, can be depicted and also the extent of historical floods can be shown. As flood extents are easy to depict they can be supplemented with point information on other flood parameters (e.g. depth or velocity at some points) and important exposed assets (e.g. hospitals, power stations).

Flood depth maps
When flood extents are calculated for specific return periods, flood depths can also easily be calculated. Depicting these water depths on a separate map results in a flood depth map. A different type of water depth map is created in areas where flooding is not the result of overtopping but rather of failing structures. In such cases it is not possible to calculate general flood extents and depth for a specific return period as the flooded area is determined by the location of a breach, which is not known beforehand, and scenarios are often used. In order to generate a general picture of the flood hazard, the results of these scenarios can be combined into a single map showing the maximum (or average) flood depth per pixel.

Maps displaying other flood parameters
Flood extents and depths are usually considered the most important flood parameters, especially when it comes to mapping flood hazards. However, some other parameters, such as velocity, duration, propagation, and the rate of rising of the water, can also be very important depending on the situation and the purpose of the map. Maps showing such parameters always relate to a single return period, as it is practically impossible to depict, for instance, velocities of several return periods on a single map.

Flood danger maps
Flood maps usually only show one out of several flood parameters, though in some cases flood depth information of a specific return period is added to a flood extent map. In order to get an impression of the overall flood hazard, parameters can instead be aggregated into qualitative classes, resulting in a so-called flood danger map. This is commonly done using matrices or formulas to relate different flood parameters into a single measure for the

“danger”. In such matrices, two axes are used to relate flood parameters (e.g. depth, velocity, return period), or sometimes a grouped parameter is used. An example of the use of a formula to calculate a measure for the flood danger can be found in the UK, where the hazard rating is defined as: depth × (velocity + 0.5) + debris factor.

Exposure and coping capacity
In flood risk management not only is information on the flood hazard desirable, but also information on the consequences of a flood. The consequences of a flood depend broadly on the damage potential and the coping capacity of a region to handle a flood. As there are countless consequences there are also many different indicators. Indicators for coping capacity (health, financial situation) are often especially difficult to quantify and are therefore usually disregarded in risk assessments (though in the UK a coping capacity map has been created). The potential damage of a flood on houses, industry, infrastructure, agriculture, etc. (exposure) is easier to assess. However, particular types of damage, such as cultural damage, ecological damage, and indirect damage (e.g. due to business disruption), are still very difficult to quantify. When such indicators are considered this is usually done in a qualitative way, resulting in indices or ratios.

Flood risk maps
When information on the consequences of a flood is combined with the hazard information, risk maps can be created. As most indicators for exposure and coping capacity are qualitative, this results in qualitative risk maps. The main quantifiable indicator for exposure is direct economic damage. A common method to calculate direct damage is by using stage-damage functions, which represent the relationship between inundation depth (and/or some other flood parameter) and the resulting damage of an object or land-use type. This yields the potential damage of an event or even the expected damage per area per year.

Stage-damage functions are either based on empirical data from past flood events or are synthetically created by experts. The use of stage-damage functions, however, still involves considerable uncertainty, and absolute damage figures should be interpreted with caution. Furthermore, the direct financial damage estimated in this way is only part of the total damage. Indirect financial damage is usually not included (or only very roughly estimated) in flood damage estimations and non-monetary damage is usually excluded altogether. As a result of the wide range of flood indicators available (for both hazard and consequence), many different types of flood maps exist. These are often not comparable (especially in the case of qualitative ones) since they are based on different approaches. In particular, flood risk maps should not be considered as homogeneous as flood hazard maps (like flood extent or depth) because of the many indicators that are available for the consequence of a flood compared to the relative few indicators for the flood hazard. In many cases the indicators used and the type of flood risk map created depends on the question that needs to be addressed. For example, insurers use insured damage, for evacuation planning population density is important, etc.

European Flood Directive requirements

In order to comply with the European Flood Directive [2007/60/EC] member states are currently obliged to create both flood hazard and flood risk maps. Flood hazard maps should cover areas that may be affected by floods with a low probability (extreme event), floods with medium probability (return period – 100 years) and, where appropriate, floods with a high probability (HQ10). Principally, the directive requires member states to create flood extent maps for the above return periods. Member states are encouraged to depict flood depth and flow velocity information as well when appropriate. The flood risk maps required by the directive are qualitative risk maps which should show the number of potentially affected inhabitants, the types of economic activity, protected areas affected, and information on possible pollution sources.

Historical data analyses established that over the last decades recurrence of disaster events have been increased in Georgia. Especially occurrence of flood/flash-flood has become more frequent. Based on this in Georgian reality flood hazard maps with a high probability ≥10 years return period would be appropriate. Regarding a low probability it’s recommended to use 0.1% (HQ1000 years).

Table 1: Summary of scenarios mapped for fluvial flooding with associated expressions of probabilities

MS	Low Probability		Medium Probability		High Probability	
	Return Period (years)	Percentage probability	Return Period (years)	Percentage probability	Return Period (years)	Percentage probability
AT	300		100		30	
BE	100 to 1000		25-50 or 100		10	
BG	Not reported					
CY	500		100		20	
CZ	500		100		20	
DE	200, 1000		100		10, 20, 25, 30	
DK	1000		100		20	
EE	1000		100		10 to 50	
EL	1000		100		20; 50	
ES	500		100		10	
FI	1000		100		50	
FR	1000		100 to 300		10 to 30	
HR	1000		100		25	
HU	1000		100		30	
IE		0.10%		1%		10%
IT	300-500		100-200		30	
LT	1000	0.10%	100	1%	10	10%
LU	Fluvial floods not mapped					
LV		0.50%		1%		10%
MT	Fluvial floods not mapped					
NL	1000		100		10	
PL	500	0.20%	100	1%	10	10%
PT	1000		100		20	
RO	1000		100		10 or 30	
SE	10000		100		50	
SI	500		100		10	
SK	1000		100		5 to 50	
UK	1000		100 to 200	1%	10 to 30	

12. CMF-2016

This section reports on the proceedings of the one hour duration Plenary Session 2 entitled 'Hazard Mapping: A Case of Georgia' held 29 November 2016 within the frames of the international conference Caucasus Mountain Forum (CMF) 2016, hosted by Tbilisi State University on 28-30 November 2016 and with participation of scientists and stakeholders from 6 Caucasus countries, as well as the guests from other mountain regions of the world.

The Panel, moderated by Mr. André Wehrli, Mountain Desk, Swiss Agency for Development and Cooperation, witnessed two PowerPoint presentations by Mr. Joseph Kinkladze, Head of Hydrometeorological Hazards Recording and Analysis Section, NEA Georgia, 'Key elements of successful partnership: NEA/SDC project on disaster risk reduction' and by Mr. George Gotsiridze, Director of GeoGraphic, Georgia, 'Hazard Mapping in Georgia: Experience and the Way Forward'.

In addition to above listed distinguished participants, Mr. Ramiz Mammadov, Director of Institute of Geography of National Academy of Science of Azerbaijan and Mr. Hamlet Matevosyan, Rector of Crisis Management State Academy, Armenia contributed with presentations and panel statements.

It is indeed worth observing, that present among the conference audience were Ms. Tamar Bagratia, Director of the Georgian National Environmental Agency (NEA); Mr. David Chichinadze, SCO Programme Officer; Mr. Olivier Bürki, Regional Director, Swiss Agency for Development and Cooperation, Office for the South Caucasus, Embassy of Switzerland and notably H.E. Mr. Lukas Beglinger Extraordinary and Plenipotentiary Ambassador of the Swiss Confederation to Georgia. All other conference participants attended this important panel discussion.

The session was initiated with opening remarks by Mr. Olivier Bürki, SDC Regional Director, inviting panellists and the conference to contribute into important discussions on hazard mapping based on pilot study implemented in Georgia. The first presenter described in details activities, methodologies and hazard categorisation criteria applied by NEA in the implementation of pilot hazard mapping study of 6 mountainous communities in Mestia Municipality of Georgia. The presentation by NEA was followed with the keynote by the GeoGraphic Director. The presentation is attached to this report as Appendix VIII and it is quote self-explanatory, essentially describing the contents and findings contained in this HazMap report, therefore the reader is directed to Appendix VIII for further insight.

The presentation of Mr. Hamlet Matevosyan, the Rector of the Crisis Management State Academy of Armenia was concerned with the following subjects: institutional mandate and structure of the Armenian Ministry of Emergency Situations, legal framework for emergency management and DRR in this country, which is ultimately concerned with the resilience and sustainability of all communities.

Mr. Ramiz Mammadov, the Director of the Institute of Geography of National Academy of Science of Azerbaijan informed, that the Ministry of Emergency Situations of Azerbaijan recently mandated the Institute of Geography with the task of preparing the Atlas for Emergency Situations for entire country. This atlas would address not only natural hazards, but also technogenic calamities and in addition, would depict various ecological, socio-economic layers, as well as the emergency response capacities in this country.

Interesting question and answer session ensued after excellent presentations by panel participants from Azerbaijan, Armenia and the keynotes by representatives from Georgia.

In particular, in response to moderator's question whether methodology similar to one demonstrated at the session could be applied for the forthcoming Atlas for Emergency Situations envisaged for Azerbaijan, Mr. Mammadov positively responded that for natural hazards indeed similar methodology can be applied, but for technogenic hazards some other approaches would be needed as well. Panel member from Azerbaijan kindly mentioned that in case of natural hazard mapping expertise and capacity building from EU countries and experience sharing with Georgia could indeed be welcome.

In response to the same question, how the hazard mapping is organised in the country and if in case of need perhaps the similar methodologies could be applicable, the panel member from Armenia, Mr. Matevosyan provided his feedback, that certain type of hazard maps (such as landslide maps, seismic risk maps, elaborated with JICA support) exist with partial coverage in Armenia (Yerevan seismic map, for instance). Azerbaijan panel member reiterated again, that they would welcome digital hazard mapping initiatives in their country.

A questions from the audience (Aram Gevorgyan, Armenia) was concerned with the Spatial Data Infrastructure related issues and the need to harmonise hazard data exchange. Armenia has certain experience with hazard and risk mapping, and question was addressed to Georgian experience. Mr. Gotsiridze responded, that both top-down and bottom-up harmonisation is required, and also the need is there for the arrangements for sharing maps with the wider public. Technical expertise is available, but decision-making arrangements for integration at all levels is indeed insufficient. In this respect sharing Swiss experience was very helpful in Georgian pilot case.

Moderator agreed that technical guidelines and expertise is indeed well developed in Switzerland, but working with stakeholders is not given for granted even in Switzerland, therefore education and awareness raising is the key, while learning should be the continuous process. Similar concern was highlighted by representative from the audience, that without adequate arrangements for public participation, hazard planning could become conflicting issue when inadequately communicated to local communities. Moderator agreed with the need to share with the public even if it is difficult sometimes, so that communities fully understand hazards faced in particular geographic context.

Interesting question of Mr. Bürki was concerned with the need to provide education curricula for hazard mapping, and whether this is addressed in panellist countries. Rector of Crisis Management State Academy mentioned, that in their institution, there are three departments – Institutional Training Department, Rescue Services Department and Public Education Department – and all these resources serve training, education and capacity building at all levels.

It was suggested from the audience that to enhance education resources EU Erasmus+ funding could be the excellent instrument for joint efforts of Azerbaijan, Armenian and Georgian educational and governance institutions to engage in 'learning by doing' process, possibly supported by the separate technical effort to develop institutional, legal and technical arrangements for hazard mapping. Institutions such as Universities of Geneva, Tbilisi State and Ilia State Universities could consider taking the initiative in support of joint proposal writing, in cooperation with competent agencies and universities from all three countries. Another intervention from audience informed that SCOPUS DRR educational project is ongoing and can be used to engage authorities and stakeholders present at the conference to immediately start supporting various hazard mapping initiatives.

On this positive note the CMF panel session devoted to hazard mapping and governance in Caucasus countries was concluded. It is worth mentioning in this respect, that in the Closure Address to the First Caucasus Mountain Forum H.E. Ambassador Beglinger highlighted importance of hazard mapping initiatives discussed a the CMF-2016 and the commitment of the Swiss Government to further support such initiatives in the countries of the Caucasus Region.

13. The Way Forward

This subsection summarises in succinct manner key recommendations derived in this report and validated through public presentation at CMF 2016. These findings and recommendations could be formulated as follows:

- Swiss HazMap methodology is indeed technically feasible and recommended for application in Georgia
- It is strongly proposed to adapt this methodology and to adopt relevant regulations, following Swiss example
- It is indeed pertinent to implement digital hazard mapping in compatibility with EU INSPIRE Directive
- In geographic context and extent, Municipalities and Communities is the application scale in Georgia
- National coverage is indeed warranted in Georgia, and this should be supported by regulatory arrangements
- Due to its sole competence, NEA is proposed to serve as lead HazMap agency, in coordination with stakeholders
- It looks most promising NEA to involve private sector by outsourcing hazard mapping with competent oversight
- Standardised terms of reference for HazMap (with proper site-specific adjustments) is recommended
- HazMap could be NEA's contribution into NSDI in harmonised manner according to INSIRE specifications
- NEA is advised to start collecting data for intensities/frequencies to fill data and methodology gaps with time
- Remote sensing could contribute to shorten event time series for hazards such as landslides
- Risk/exposure analysis seems also feasible and there is a need to reflect these layers into spatial plans

- NEA data sharing polices may need certain modifications for disclosure of HazMap related data to public
- Swiss workflow and reporting format is also feasible and is advised for adaptation in Georgia
- It is encouraging that changes in legislation many not be required, rather only changes in key regulations
- Swiss data model seems attractive to other counters of the Caucasus Region (such as Azerbaijan)
- There is a range of other recommendations and findings, which are described elsewhere in this report.

14. Documentation

The following comprehensive documentations and existing data was provided to GeoGraphic at the outset of this review, and while in the course of the analysis contents and compendium of references was substantively extended further, we would like to list hereby the documents received at the study initiation step.

NEA provided the following documents and data via SCO:

Geological Report for the Landslide, Mudslide and Rockfall Hazard Assessment and Territorial Zoning of Mestia Municipality, MoE/NEA, Geology Department, Tbilisi, 2015, 76 pages, with annexed 29 Maps (in Georgian).
- Annexed are also 3 criteria sheets elaborated for landslides, rockfalls and mudslides
- Landslide, rockfall and mudslide data sheets for Svaneti
- Certain datasets in geodatabase format
- Certain meteorological data in excel files

Mestia Municipality 'Disaster Risk Reduction' Project Report (Flooding and Avalanches), MoE/NEA, Hydrometeorology Department, Tbilisi, 2015, 70 pages (in Georgian)
- Flooding maps (3 jpg and respective shapefiles)
- Avalanche data in shapefiles

CSO also provided following reference documentations:

Documents
- Sample templates: Call for tenders for the development of a risk map (Canton of Luzern, 2012) (in German)
- Guidelines for establishing digital hazard maps (Canton of Luzern, 2009) (in German)
- Fact sheet - revision of hazard maps (Canton of Luzern, 2012) (in German)
- Fact sheet - revision of hazard maps (Canton of Luzern, 2012) (in Georgian, unofficial translation)
- Handling risk maps in integral protection projects (Canton of Luzern, 2012) (in German)
- Handling risk maps in integral protection projects (Canton of Luzern, 2012) (in Georgian, unofficial translation)
- D. Bollinger, H.R. Keusen (Chairman), H. Rovina, A. Wildberger and R. Wyss, Classification of dangerous landslides, Permanent landslides, spontaneous landslides and debris flows, Federal Office for water and geology, Zollikofen, 24. Mach 2004 (in German)
- D. Bollinger, H.R. Keusen (Chairman), H. Rovina, A. Wildberger and R. Wyss Classification of dangerous landslides, Permanent landslides, spontaneous landslides and debris flows, Federal Office for water and geology, Zollikofen, 24. Mach 2004 (in Georgian)
- Mestia Hazard Risk Mapping Terms of Reference (from SDC to NEA) (in German)
- Mestia Hazard Risk Mapping Terms of Reference (from SDC to NEA) (in Georgian)

PowerPoint presentations

- Important Landslide Parameters – The Swiss Concept, Daniel Tobler and Hans Rudolf Keusen, February 10th 2011, GeoTest. (in English)
- Hazard Zoning in Areas with Major Deep-Seated Landslides – Case Study from Switzerland, Daniel Tobler and Hans Rudolf Keusen, October 4th 2011, GeoTest. (in English)
- Geohazard Mapping Methodology – Practical Steps and Results (in Georgian)
- IRM Engelberger AA, Canton Nidwalden, Switzerland, IRM course Tbilisi, 27.02.14 (in English)
- Introduction Course Integrated Risk Management, 24. February 2014 - 28. February 2014 Georgia/Tbilisi, Sandro Ritler / Andrea Pozzi / David Chichinadze
- Hazard Mapping for Mestiachala Basin in Mestia Municipality (near airport)

Sample Video

- Flood modelling visualisation

Reference is made also to following PhD Thesis:

- George Gotsiridze, Investigation of Geodynamic Processes with Remote Sensing Methods (Case Study of Upper Svaneti), Iv. Javakhishvili Tbilisi State University, Thesis Manuscript for the Degree of the Candidate of Geographic Sciences, Tbilisi, 1996 (Manuscript, in Georgian)

References to some other required documents are provided elsewhere in the text (such as further references to Swiss regulations setting out hazard mapping procedures, Georgian NSDI process, EU INSPIRE Directive and its data specifications related to hazard mapping, other references).

15. Deliverables

GeoGraphic produced following deliverables, as specified in the ToR, methodology and work plan:

a) Detailed work plan with the description of the process, the methodology to be used, the data required, and a timeframe to accomplish the assignment (two weeks);
b) The draft report on the assessment of the Hazard Mapping Methodology (end of month 2) including the following:
c) Recommendations on development of general procedure for setting up a system and legal framework for the application of Hazard Mapping at all governmental levels (end of month 2).
d) This final report describing process and deliverables achieved (two weeks after presentation and agreement of the findings and recommendations with the stakeholders).

The following reports are forthcoming:

e) Presentation and agreement of findings and recommendations with the stakeholders (by end of month 3);

As a value added to above mentioned deliverables, GeoGraphic delivers the following as well:

f) Preliminary presentation for rehearsal meeting with the SCO to appraise the produced results prior to CMF 2016.
g) Participation in the Caucasus Mountain Forum (CMF) 2016, presentation of findings (ppt in English) and public discussion of the review results and the way forward.
h) A demonstration package of GIS files for Mestia pilot area, as well as set-up of a small NSDI compatible portal/facility to demonstrate how datasets can be shared in format compatible with Swiss hazard mapping style. This product is for demonstration at CMF 2016 in the form of the geonode, storing and visualising online sample layers and maps of hazard mapping results.

16. Work Progress

All above considerations are reflected in more detailed Work Plan table reproduced below.

Timeline / Activities (Deliverables)	August				September				October				November, 2016			
	1w	2w	3w	4w	1w	2w	3w	4w	1w	2w	3w	4w	1w	2w	3w	4w
Inception phase (Work Plan)	o	X														
Review of Hazard Mapping Methodology (Assessment)	o	o	o	o	o	o	o	x	o	o	o	o	o	X		
Regulations on Hazard Mapping (Recommendations)	o	o	o	o	o	o	o	x	o	o	o	o	o	X		
Consultations with stakeholders and client (presentation)	o	o							o	o	o	X	o	X		
CMF 2016 participation (registration, presentations)		o	X	o							o	o		X		X
INSPIRE compatible page (GIS pack, demo Web-GIS)	o	o	o	o	o	o	o	o	o	x	o	X		X		
Findings of the study and way forward (Final Report)															X	

Work Plan Legend:

X – Deliverable as completed (and planned)
x – Deliverable as planned
o – Activity as completed
– Activity as planned
– Activity deviation/delay

17. Team

GeoGraphic team composition was strengthened further by three experienced lawyers (see complete list below):

1. George Gotsiridze, Team Leader and Expert in Geomorphology/Geo-Ecology
2. Mamuka Gvilava, Project Manager and Environmental Expert
3. Malkhaz Khurtsidze, Land Management Specialist/Cartographer
4. Tamar Bakuradze, Environmental Expert/Cartographer
5. Tinatin Janelidze, GIS Expert/Cartographer
6. Yuri Kolesnikov, GIS and DB Manager
7. Rezi Kenia, GIS Server Administration
8. Irina Vartanova, Programmer
9. Ekaterine Khokhiashvili, GIS Specialist
10. David Pataraia (Partner, http://kjlaw.ge)
11. Irakli Kordzakhia (Partner, http://kjlaw.ge)
12. Nino Soselia (Senior Associate, http://kjlaw.ge)

18. Acknowledgements

GeoGraphic would like to express its sincere gratitude towards very good cooperation and support extended by the key project partners and stakeholders, primarily the programme officer of the Swiss Cooperation Office in Georgia, Chairperson and key personnel of NEA from all thematic areas involved in this and precursor study for useful review and recommendations included in this report as well. Support of the University of Geneva for allocating the hazard mapping presentation and discussion session, as well as for support in SDI deployment and demonstration at CMF 2016 is thankfully appreciated. Gratitude is expressed to GeoGraphic's team, including partners from K&J Law Firm for legal & institutional analysis.

Appendix I. HazMap Summary

Transport and infrastructure department

Leaflet on Hazard Mapping

Hazards processes

Water process

All dangers arising from water bodies are investigated. Not shown are hazards caused by slope water and overburdened settlements

Floods

Debris flow

Slipping process

Dangers arise both from permanent and spontaneous landslides as well as from, liquefied, fast-going debris flows.

Landslides

Landslips

Fall process

Looked at are dangers of rockfalls. These can be single blocks (block impact) or entire rock sections (rockfalls).

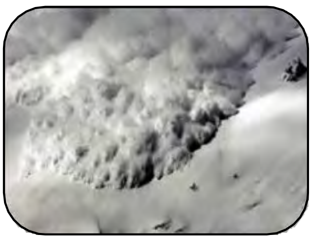
Block impacts

Rockfalls

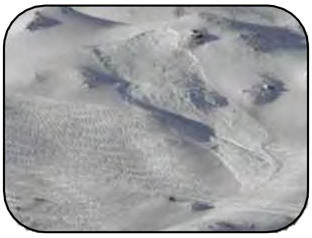
Avalanche process

Isolated residential dwellings or important traffic routes are threatened by sudden ice and snow. Nevertheless, a number of fatal avalanche accidents reported in recent years.

Rolling avalanche



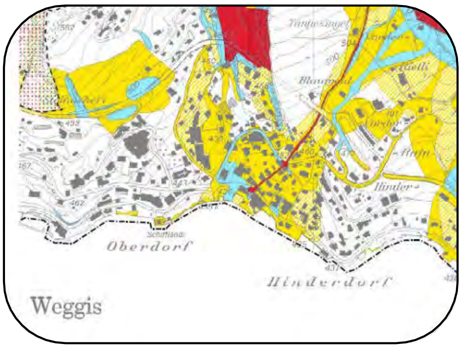
Slipping avalanche



Working depths

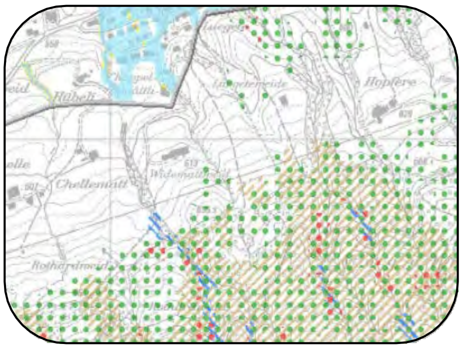
The hazard assessment is dealt with in two processing depths.

Within perimeter:
Deepened hazard assessment



Due to comparatively high costs, the hazards are only analysed in the area of building zones by experts and are presented according to the prevailing hazard level (yellow, blue, red). This area is called "Perimeter with Detailed Hazard Assessment". According to the state of knowledge, white areas are not endangered.

Outside perimeter:
Rough indications of possible hazard



Outside of the construction zones, the dangers are only estimated in lumped way by means of computer-aided modelling without field verification and are presented as hazard warnings. Those just provide a rough overview and show where it is appropriate to look more closely. White areas are not considered safe and must be examined more closely.

Basic principles

Hazard maps are prepared by specialized experts using uniform methods. The following are the basic principles on which maps are based:

Findings from past events

Documents from the event cadastre and studies based on experiences of local residents.

Terrain observations

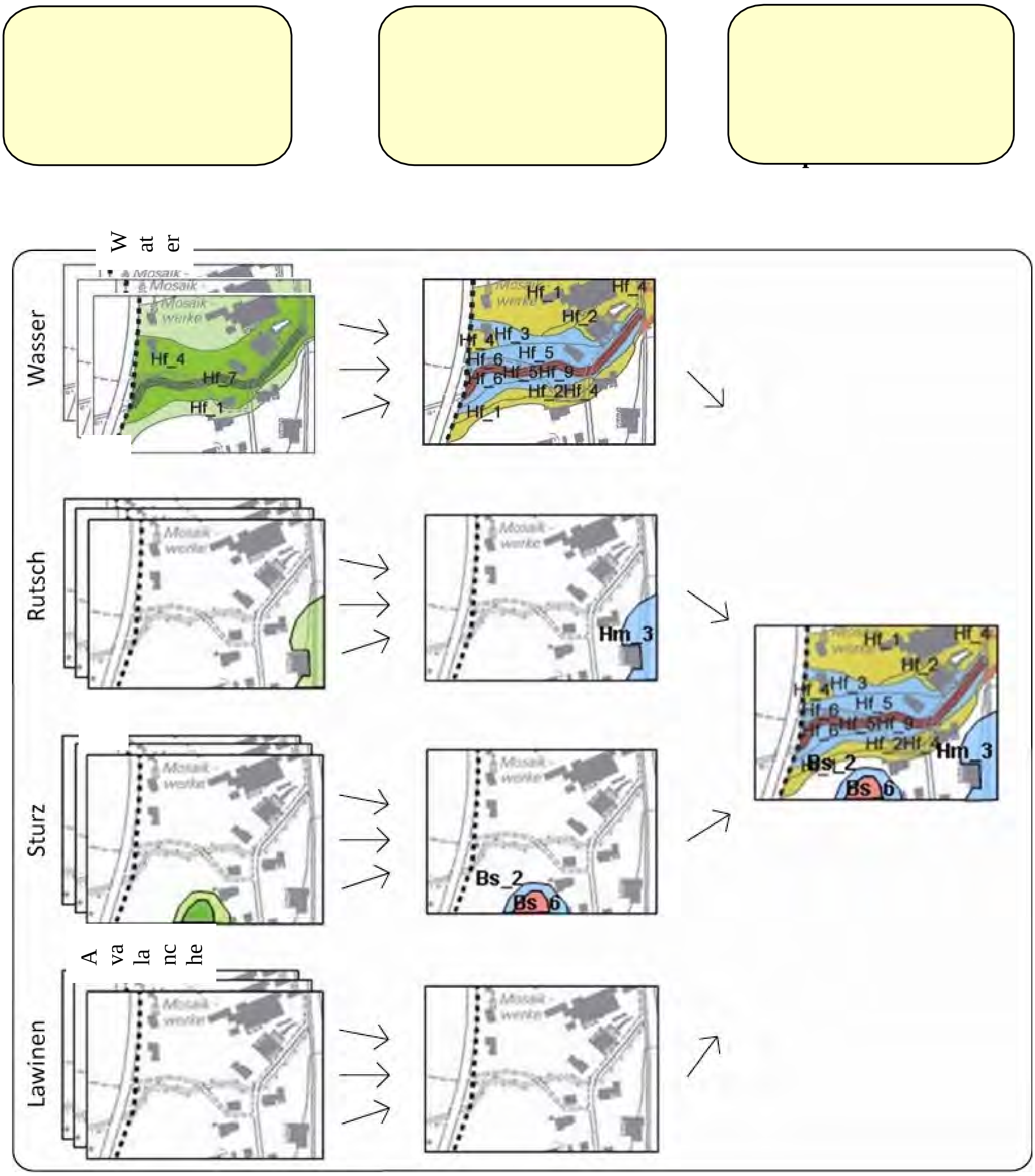
The site investigations by experts, inspecting the areas of interest and all relevant hazard issues on site.

Calculations and modelling

Various scenarios are modelled and simulated using computer programs.

Development of hazard maps

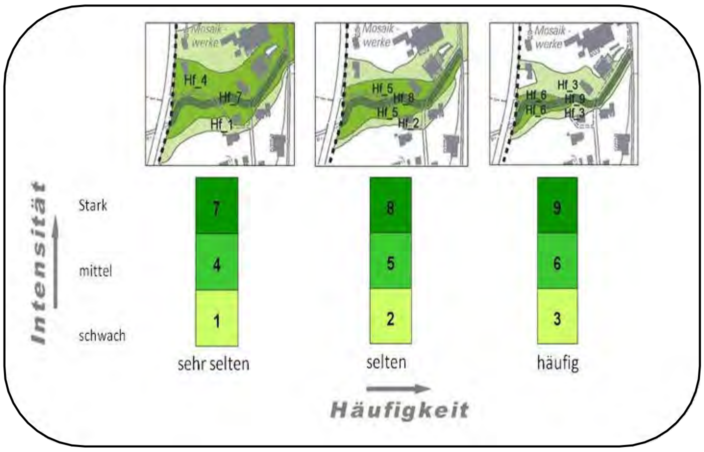
Hazard maps are composed of various constituent maps.



Explanations for the individual constituent maps follow on the next pages.

Intensity maps

Weak events occur frequently, strong events are, of course, less frequent. In order to meet this basic idea, intensity maps are created for each of the four hazard processes (water, landslide, rockfall, avalanches), one for the three occurrence probabilities (very rare, rare, frequent). Three green tones show the intensity (severity) of the hazard. Thus, 12 maps are required for hazard mapping.



Frequency
The frequency shows the return period, in which an event has to be expected.

Very rare,
1 x in 300 Years
means the „worst case accident“ frequency.
.

Rare,
1 x in 100 Years
A "centennial event". This event is not the happening in every lifetime generation.

Frequent,
1 x in 30 Years
Event can indeed occur, which almost every member of the fire brigade would have experienced one or more times.

Intensity
The intensity of an event provides information about its strength. Information on the various processes can be found in the annex.

Weak
Knee-deep water, small stones and manageable mass of mud have a weak intensity.

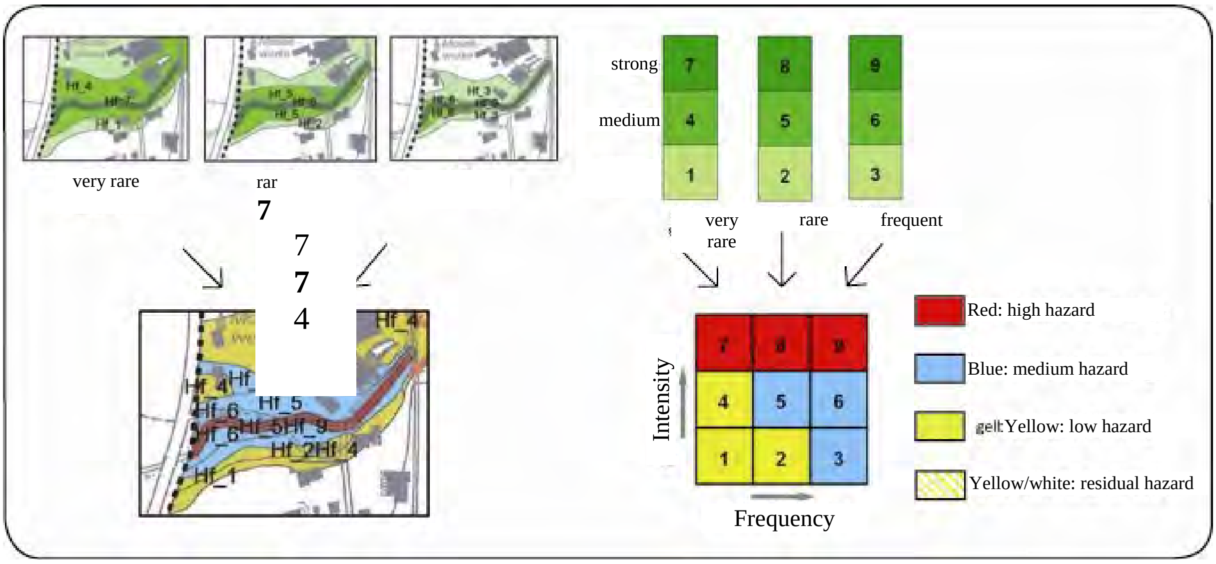
Medium
In case of water, an average intensity event with water depths of between 0.5 m and 2 m or with a flow velocity of 0.5 to 2 m/s.

Strong
High flood depths or large rock or earth masses acquire a strong intensity.

Process-specific hazard maps

As the three intensity maps of a process type (for example, water) are combined, a process-specific hazard map (for example, the water hazard map) is created. The information on the hazard intensity as well as the frequency are decisive for mapping the hazards of an area. A colour (red, blue, yellow) is assigned to the individual fields of the 9-cell diagram (1-9) according to the particular hazard under consideration.

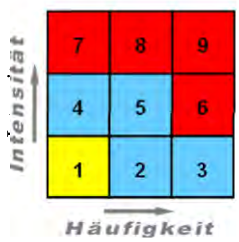
Knowledge of events that need to be expected less than once per 300 years, e.g. extremely high water or known landslide areas, are marked as a residual hazard on the hazard map.



This transformation of intensity and frequency into the hazard levels does not occur in every process in a similar way. A distinction has to be made between fast and slow processes.

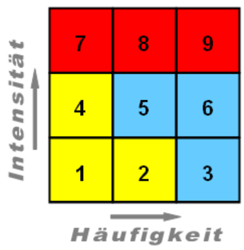
Fast processes

To state it direct, "brutal" processes such as rockfalls, landslides and avalanche leave little time for reaction. They are classified as more dangerous, i.e. more cells and consequently more land areas are classified to be of high (red) and of medium (blue) hazard.



Slow processes

Slowly occurring processes, such as floods, where there is some time to keep people and property safe, are classified as less hazardous. In this case, fewer fields are in the 9-cell diagram - or even areas on the map - painted in red and blue.

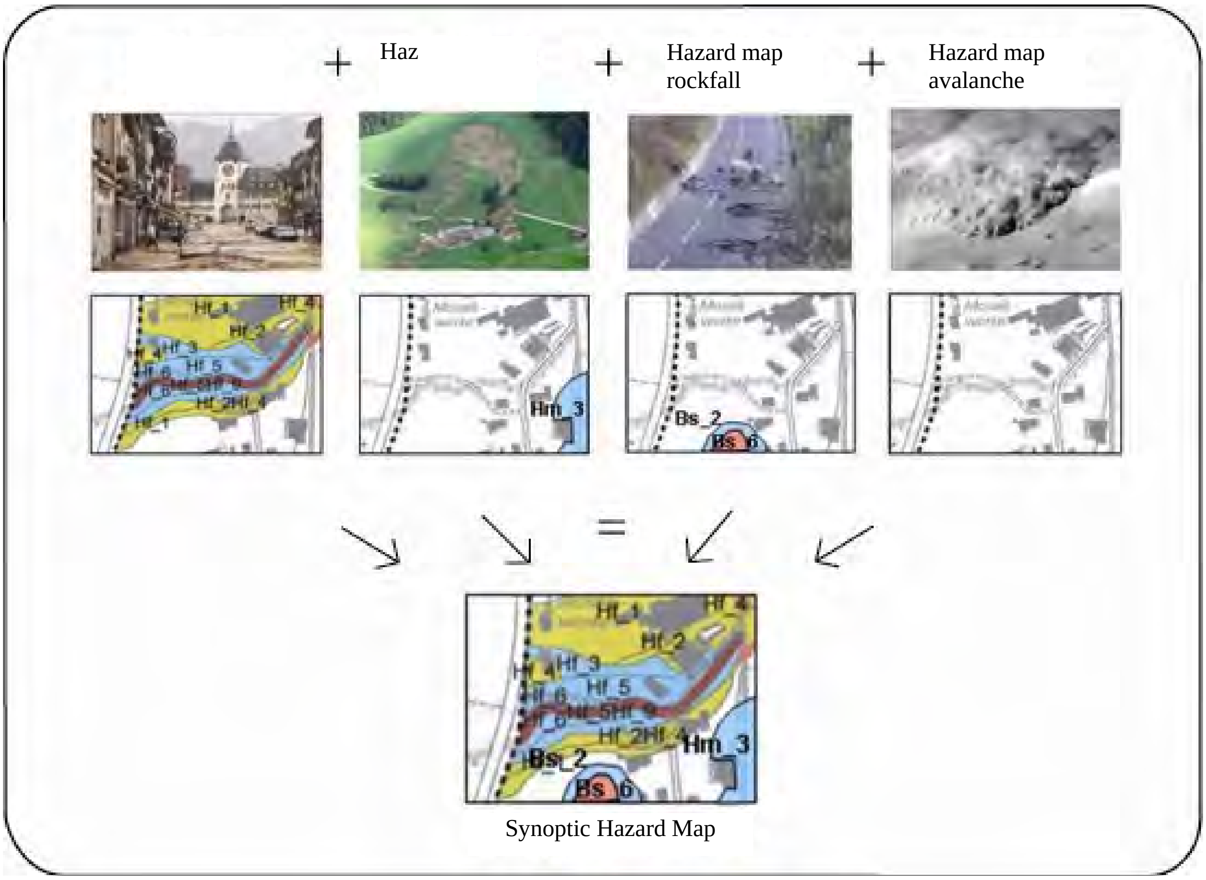


Synoptic hazard maps

Synoptic means "seamlessly juxtaposed" or "overlaid". The Synoptic Hazard Map shows all hazards, irrespective of whether they are caused by water, landslide, rockfall or avalanches. The Synoptic Hazard Map thus provides an overview of the hazard situation:

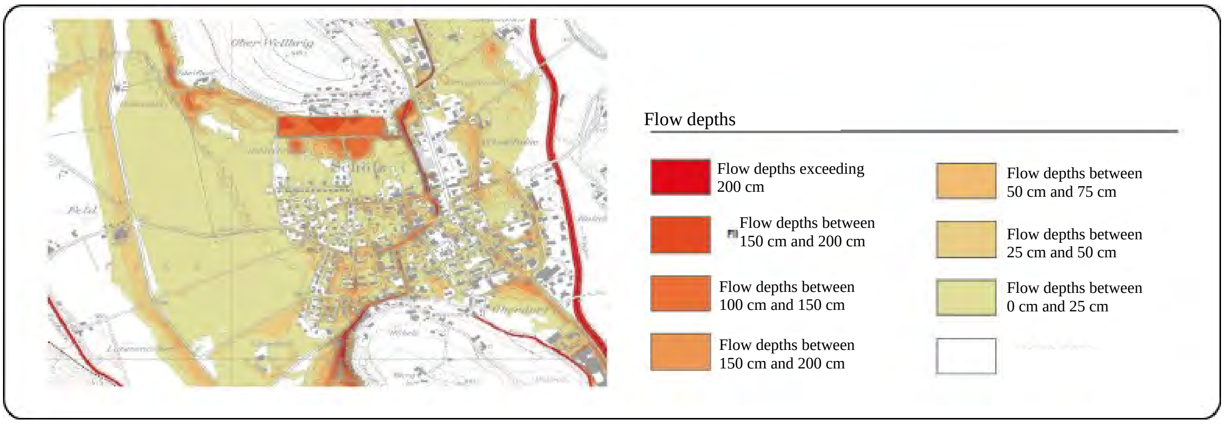
- Areas, which are displayed white on the Synoptic Hazard Map, are considered to be safe according to the current state of knowledge and the processing depth.

- Areas marked yellow, blue or red are considered to be hazardous. In order to determine which processes are causing the hazard, the process hazard maps must be consulted.



Special case: flood depth maps / flood maps

Flow depth maps and flood maps are special intensity maps, on which the intensity – in this case the water level – is displayed in a particularly fine gradation. Their preparation is quite complicated. Therefore, flow depth and flood maps are usually only created for specific heavily populated valleys.



Hazard map revision / update

The hazard cards are periodically revised. More information can be found in the leaflet "Revision of Hazard Maps" of the Department of Natural Hazards under the following link:
http://www.vif.lu.ch/naturgefahren_merkblatt_ueberarbeitung_gk_1.1.pdf

Further information

- http://www.vif.lu.ch
- Transport and Infrastructure Service, Natural Hazards, Tel. 041 318 12 12

Annex 1: Intensities

Process	**Weak intensity**	**Average intensity**	**Strong intensity**
Avalanches, snow slides	$P <= 3 kN/m^2$	$3 kN/m^2 > P > 30 kN/m^2$	$P > 30 kN/m^2$
Stone and block fall	E < 30 kNm	30 kNm < E < 300 kNm	E > 300 kNm
Rockfall	not applicable	not applicable	E > 300 kNm
Landslide permanent, subsidence	v < ca. 2 cm/year	2 cm/year < v < 1 dm/year	v > 1 dm/year
	vmax > 3-5 dm / year → D: 2-10 cm / 10 m → ← Gf > 30 u. T.	vmax > 3-5 dm / year → D: 2-10 cm / 10 m → ← Gf > 30 u. T.	
	vmax > 7dm / year → ← D > dm / 10m		
Mudflow and mudslide	h < 0.5 m *and* v < 1 m/s *and* V < 500 m3	h < 1 m *and* v < 1 m/s *and* irrespective of V	h > 1 m *and* v > 1 m/s *and* irrespective of V
Landslide spontaneous, riverbank slump	d < 0.5 m *and* l < 1 m	0.5 m < d < 2 m *or* d < 0.5 m *and* l > 1 m	d > 2 m
High water including transitional	h < 0.5 m *or* $v \cdot h < 0.5 m^2/s$	0.5 m < h < 2 m *or* $0.5 < v \cdot h < 2 m^2/s$	h > 2 m *or* $v \cdot h > 2 m^2/s$
Shore erosion	d < 0.5 m	0.5 m < d < 2 m	d > 2 m
Collapse	If dolines are present, additional clarifications are to be made in consultation with the Department of Natural Hazards.		

P = Pressure
d = Average thickness of the ablation (measured perpendicular to the slope surface)
h = Flow or deposition depth
l = Distance of landslide movement
v = Flow speed

V = Volume
E = Energy
v_{max} = Maximal landslide speeding during acceleration phase
D = Differential movements
Gf = Depth of the landslide, depth of the slipping

Annex 2: Abbreviations for identification of sub-processes

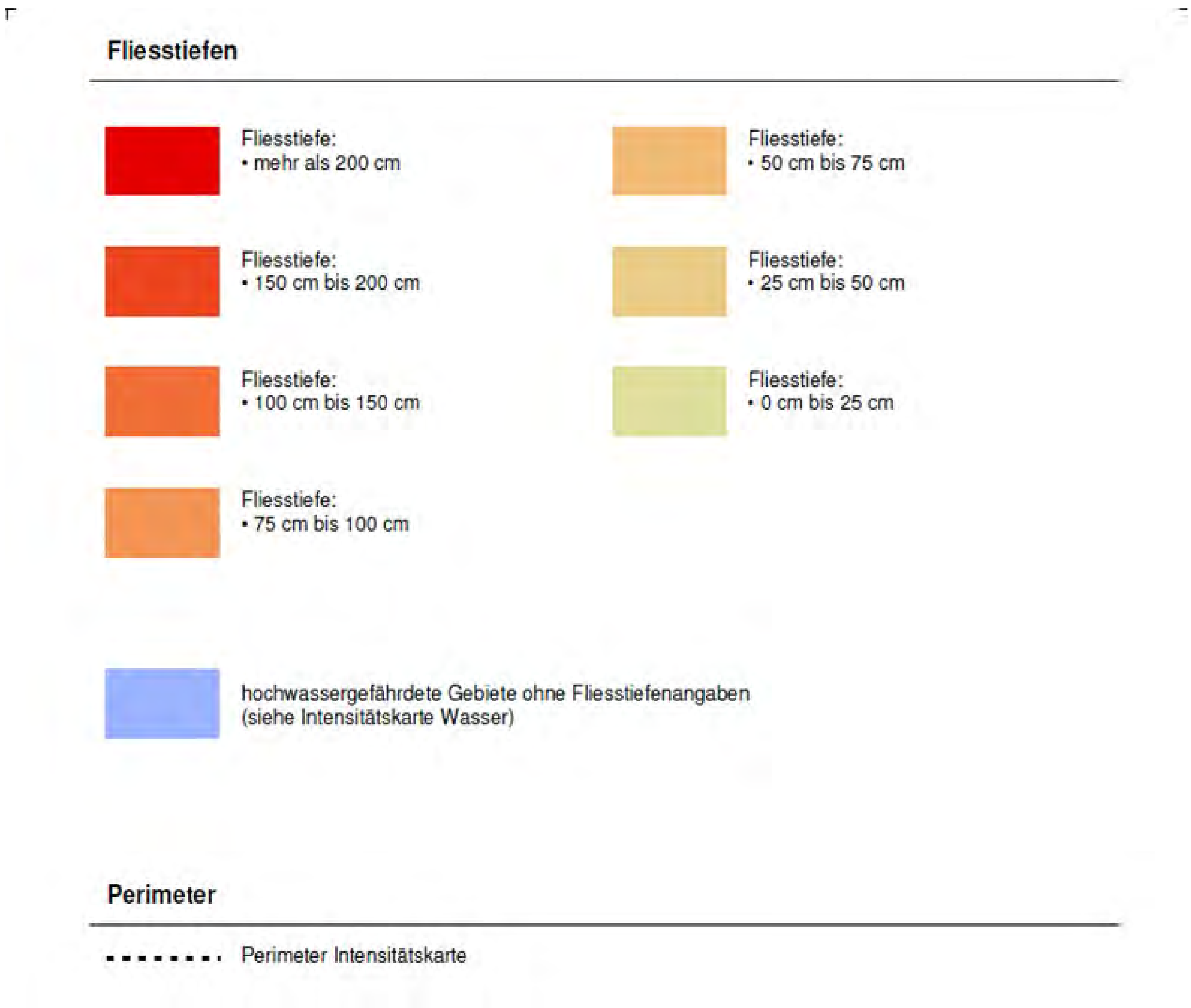
Main processes	Secondary processes in English (and German)	Abbreviation	Code	Subcode
Water (**W**asser)	Flood_flowing (**H**ochwasser_**f**liessend)	Hf	1	11
	Flood_standing (**H**ochwasser_**s**tehend)	Hs		12
	Mudflow (**M**urgänge)	M		13
	Shore erosion [15] (**U**fer**e**rosion)	Ue		14
Fall (**S**turz)	Stone-fall (**S**tein**s**chlag)	Ss	2	21
	Block-fall (**B**lock**s**chlag)	Bs		22
	Rock-fall (**F**els**s**turz)	Fs		23
Landslide (**R**utsch)	Permanent_landlisde (**p**ermanente_**R**utschungen)	pR	3	31
	Spontaneours_landlisde (**s**pontane_**R**utschungen)	sR		32
	Shallow landslide (H**a**ng**m**uren)	Hm		33
	Bank slump [16] (**U**fer**r**utschungen)	Ur		34
	Sackings (**S**ackungen)	Sa		35
	Subsidence (**A**b**s**enkungen)	As		36
	Collapse (**E**in**s**turz)	Es		37
Avalanches (**L**awinen)	Flow avalanches (**F**liess**l**awinen)	Fl	4	41
	Dry avalanches (**S**taub**l**awinen)	Sl		42
	Snowslide (**S**chnee**r**utsche)	Srl		43

[15] Shore erosion usually extends to a width of a few meters and can often not be shown in a scale of 1: 5'000. Shore erosion is therefore to be noted on the map with a sign or text and should be explained in the technical report.
[16] Bank slides are comparable to spontaneous landslide as a process and with effects induced.

Appendix II. Legends

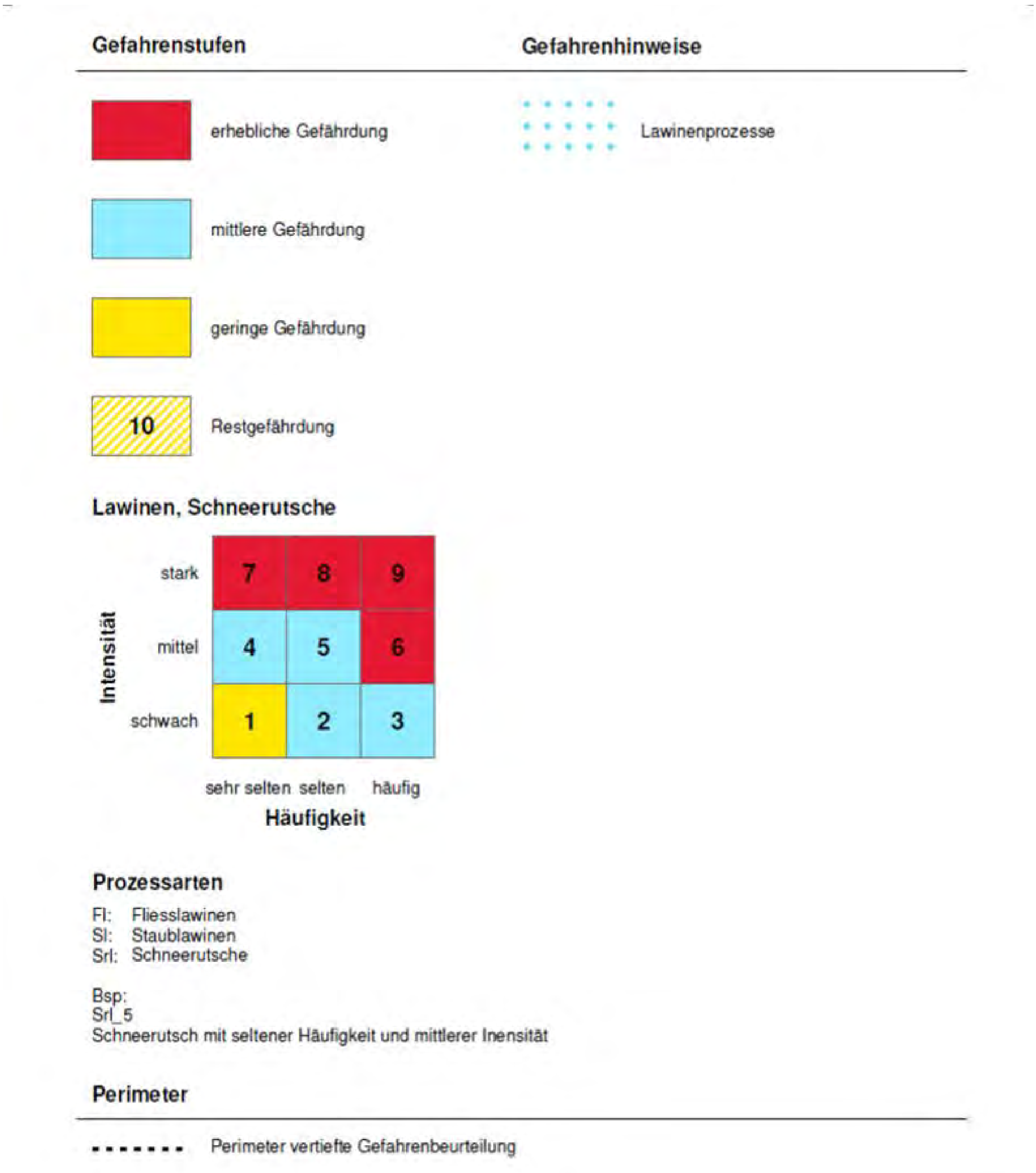
Flow depth / Flood map

Map legend



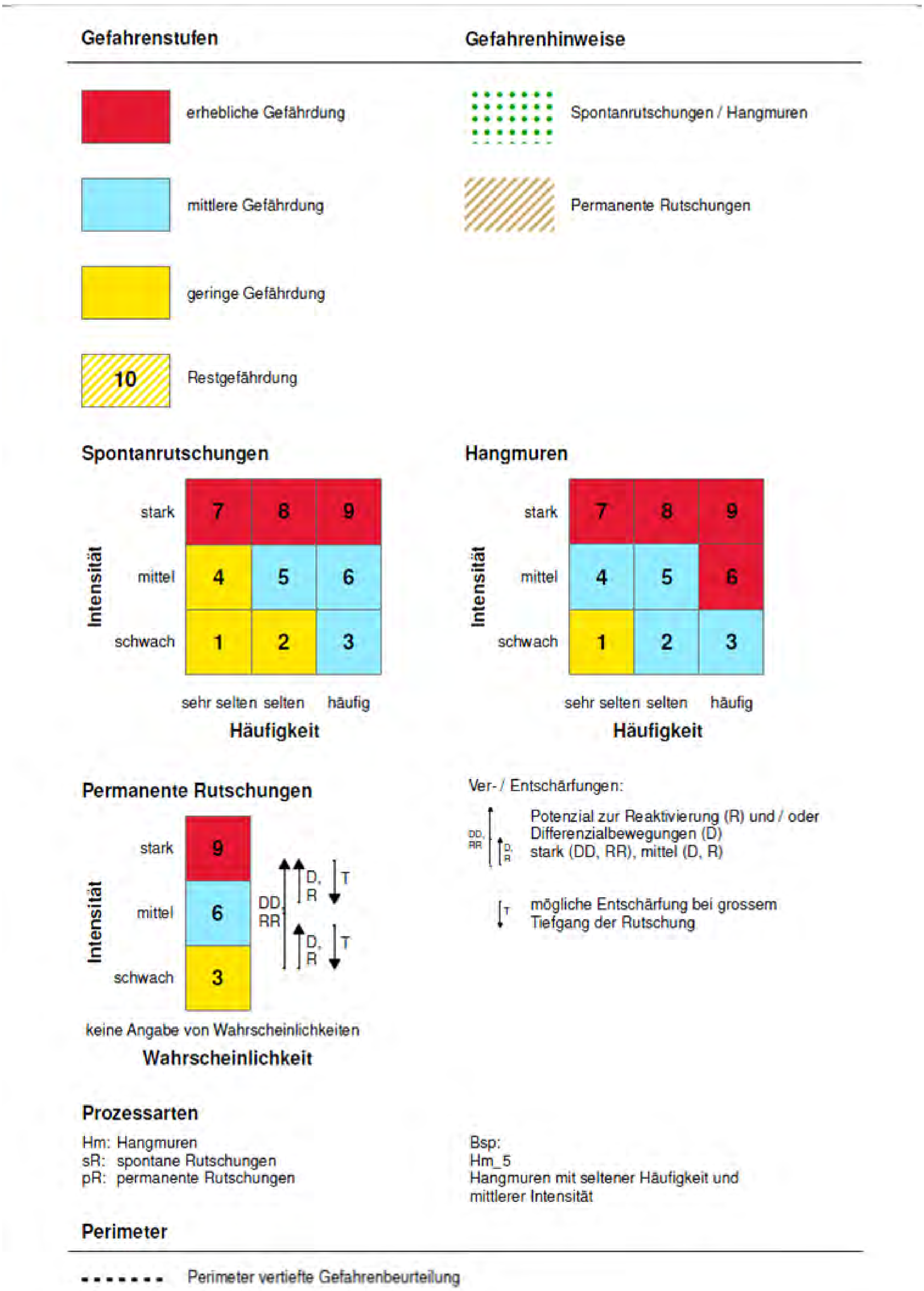
Hazard Map Avalanches

Map legend



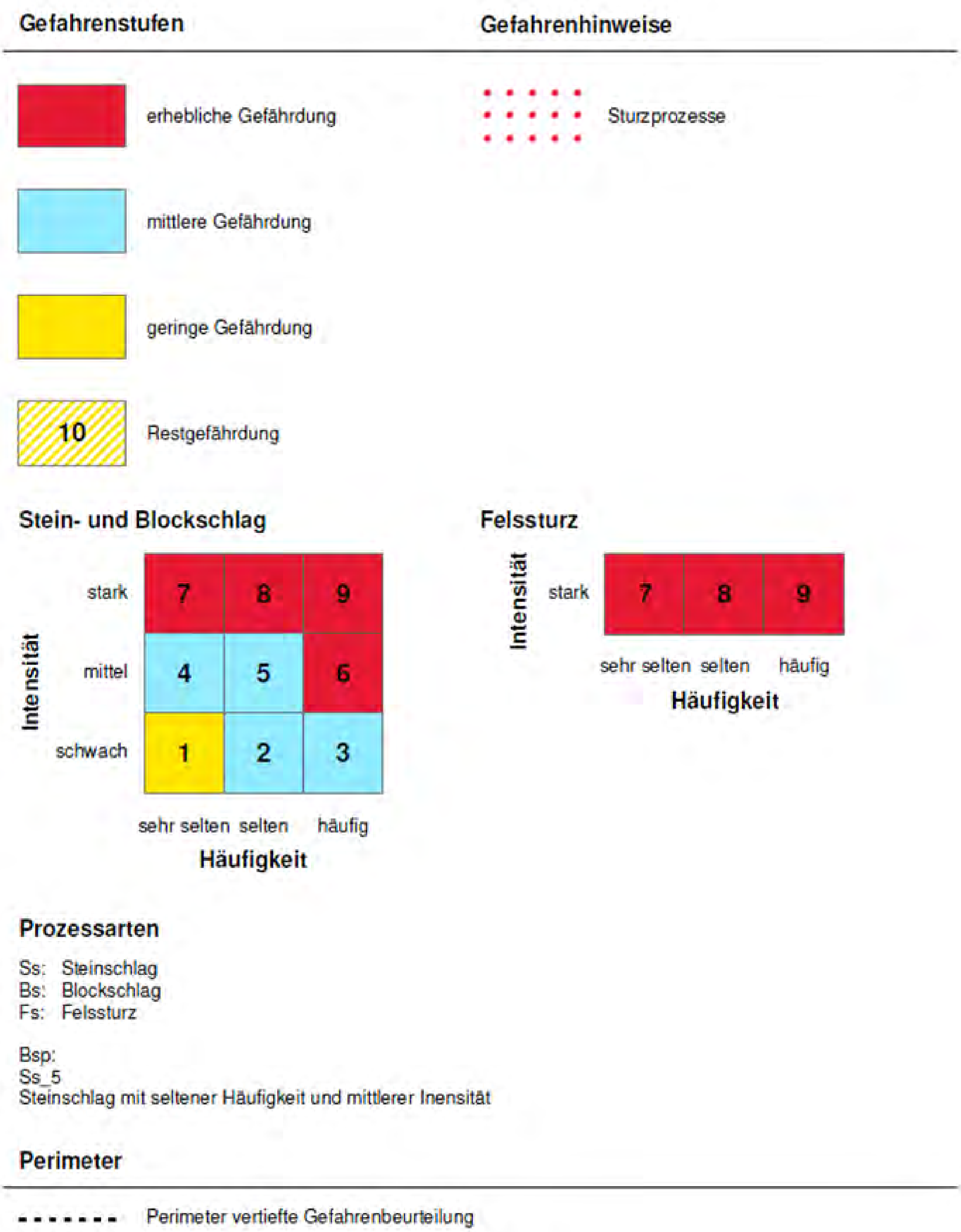
Hazard Map Landslides

Map legend



Hazard Map Rockfall

Map legend

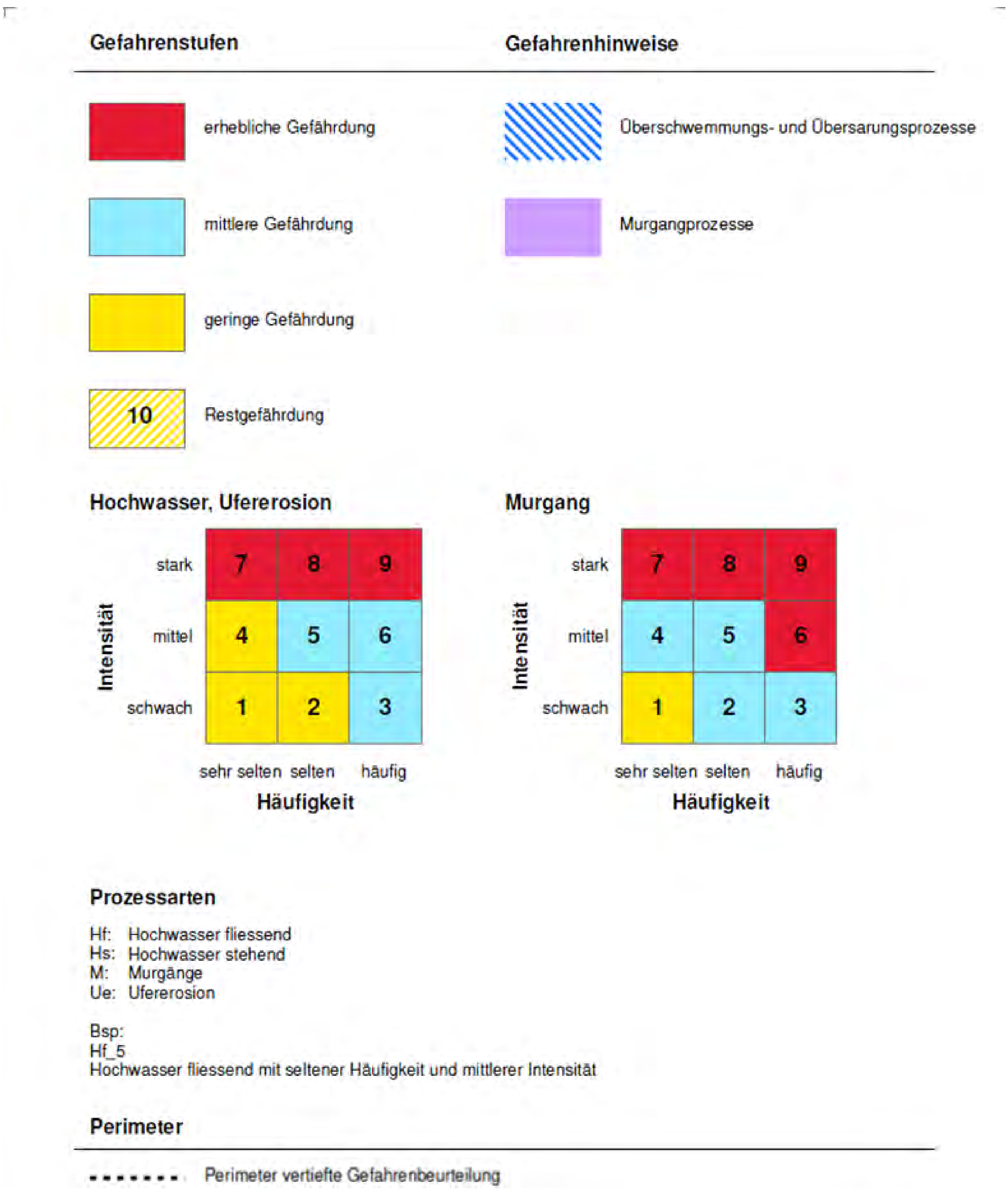


Synoptic Hazard Map

Map legend

Hazard Map Water

Map legend



Intensity Map Avalanches
Map legend

Intensitäten

Starke Intensität:
Lawinen, Schneerutschung:
• $P > 30$ kN/m^2

Mittlere Intensität:
Lawinen, Schneerutschung:
• 3 kN/m^2 $> P >$ 30 kN/m^2

Schwache Intensität:
Lawinen, Schneerutschung:
• $P <= 3$ kN/m^2

Erläuterung
P = Druck [kN/m^2]

Prozessarten

Fl: Fliesslawinen
Sl: Staublawinen
Srl: Schneerutsche

Bsp:
Srl_5
Schneerutsch mit seltener Häufigkeit und mittlerer Inensität

Perimeter

······· Perimeter Intensitätskarte

Intensity Map Landslides

Map legend

Intensitäten

Starke Intensität:

Hangmure:
- h > 1 m und
- v > 1 m/s
- unabhängig von V

Rutschung spontan, Uferrutschung:
- d > 2 m

Rutschung permanent, Absenkung:
- v > 10 cm/Jahr
  oder
- 2 cm/Jahr < v < 10 cm/Jahr + R oder D
  oder
- v < 2 cm/Jahr + RR oder DD

Mittlere Intensität:

Hangmure:
- h < 1 m und
- v < 1 m/s
- unabhängig von V

Rutschung spontan, Uferrutschung:
- 0.5 m < d < 2 m
  oder
- d < 0.5 m und l > 1 m

Rutschung permanent, Absenkung:
- 2 cm/Jahr < v < 10 cm/Jahr
  oder
- v < 2 cm/Jahr + R oder D

Schwache Intensität:

Hangmure:
- h < 0.5 m und
- v < 1 m/s und
- V < 500 m^3

Rutschung spontan, Uferrutschung:
- d < 0.5 m und
- l < 1 m

Rutschung permanent, Absenkung:
- v < 2 cm/Jahr

Erläuterung

h = Fliess- repsektive Ablagerungshöhe [m]
v = Fliessgeschwindigkeit [m/s]
V = Volumen [m^3]
d = mittlere Mächtigkeit der Abtragung (gemessen rechtwinklig zur Böschungsoberfläche) [m]
l = Distanz zur Rutschbewegung [m]
R = Reaktivierung mittleren Ausmasses: 2v < dv < 10v [cm/Jahr]
RR = Reaktivierung starken Ausmasses: dv > 10v [cm/Jahr]
D = mittlere differenzielle Bewegungen: 1 < dl < 2 [cm/m und Jahr]
DD = starke differenzielle Bewegungen: dl > 2 [cm/m und Jahr]

Prozessarten

Hm: Hangmuren
sR: spontane Rutschungen
pR: permanente Rutschungen

Bsp:
Hm_5
Hangmuren mit seltener Häufigkeit und
mittlerer Intensität

Perimeter

Perimeter Intensitätskarte

Intensity Map Rockfall

Map legend

Intensitäten

Starke Intensität:
Stein- und Blockschlag:
• E > 300 kNm

Mittlere Intensität:
Stein- und Blockschlag:
• 30 kNm < E < 300 kNm

Schwache Intensität:
Stein- und Blockschlag:
• E < 30 kNm

Erläuterung

E = Energie [kNm]

Prozessarten

Ss: Steinschlag
Bs: Blockschlag
Fs: Felssturz

Bsp:
Ss_5
Steinschlag mit seltener Häufigkeit und mittlerer Inensität
(Nummer gemäss Gefahrenstufendiagramm auf Einzelgefahrenkarte Sturzgefahren)

Perimeter

- - - - - - - Perimeter Intensitätskarte

Intensity Map Water

Map legend

Intensitäten

Starke Intensität:

Hochwasser inkl. Übersarung:
- h > 2 m

oder
- v * h > 2 m2/s

Ufererosion:
- d > 2 m

Murgang:
- h > 1 m und
- v > 1 m/s und
- unabhängig von V

Mittlere Intensität:

Hochwasser inkl. Übersarung:
- 0.5 m < h < 2 m

oder
- 0.5 m2/s < v * h < 2 m2/s

Ufererosion:
- 0.5 m < d < 2 m

Murgang:
- h < 1 m und
- v < 1 m/s und
- unabhängig von V

Schwache Intensität:

Hochwasser inkl. Übersarung:
- h < 0.5 m

oder
- v * h < 0.5 m2/s

Ufererosion:
- d < 0.5 m

Murgang:
- h < 0.5 m und
- v < 0.5 m/s und
- V < 500 m3

Erläuterung

d = mittlere Mächtigkeit der Abtragung (gemessen senkrecht zur Böschungsoberfläche) [m]
h = Fliess- resp. Ablagerungshöhe [m]
v = Fliessgeschwindigkeit [m/s]
V = Volumen [m^3]

Prozessarten

Hf: Hochwasser fliessend
Hs: Hochwasser stehend
M: Murgänge
Ue: Ufererosion

Bsp:
Hf_5
Hochwasser fliessend mit seltener Häufigkeit und mittlerer Intensität
(Nummer gemäss Gefahrenstufendiagramm auf Einzelgefahrenkarte Wassergefahren)

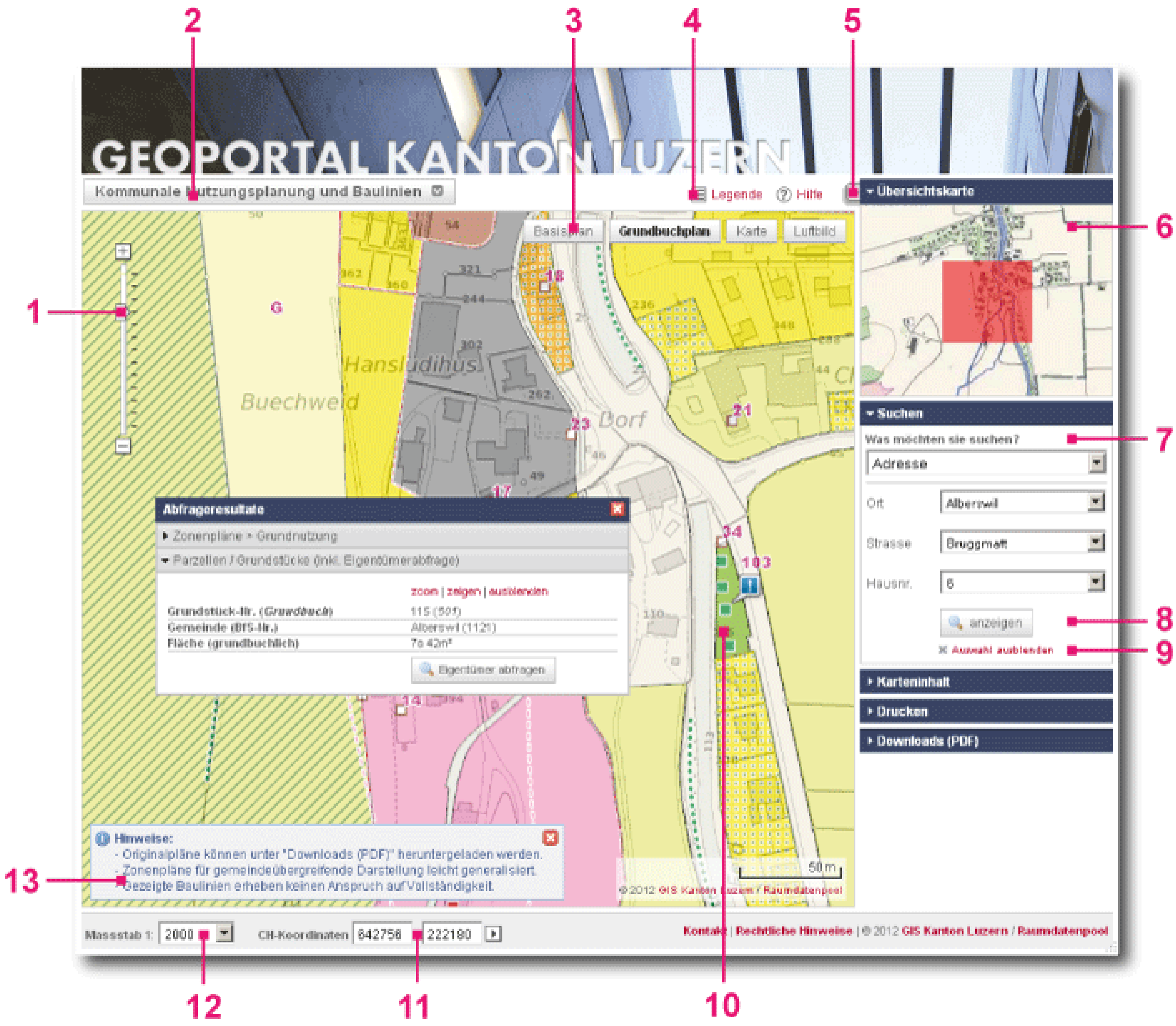
Perimeter

- - - - - - - Perimeter Intensitätskarte

Appendix III. HazMap Web Portal Navigation

Online-Karten

Überblick



1. **Navigation in der Karte -** Pfeil nach oben oder unten schieben, um die Karte zu vergrössern bzw. zu verkleinern. Vergrössern ist auch mit Doppelklick in Karte möglich. Um Kartenausschnitt zu verschieben, Karte bei gehaltener Maustaste ziehen.
2. **Kartenauswahl-** Auf Kartentitel klicken, um Auswahlliste aller verfügbaren Karten anzuzeigen. Bei Kartenwechsel werden aktueller Massstab und Kartenausschnitt beibehalten.
3. **Hintergrundkarte wechseln -** Wählen sie zwischen verschiedenen Hintergrundkarten.
4. **Kartenlegende -** Klicken, um Legende anzuzeigen. Legendenfenster kann mit Maus verschoben werden.
5. **Vollbildmodus -** Auf Lasche klicken, um die Seitenleiste auszublenden und Kartengrösse zu maximieren.
6. **Übersichtskarte -** Diese Orientierungshilfe zeigt die aktuelle Umgebung des Kartenausschnittes.
7. **Suchen -** Suchen sie auf einfache Weise Adressen, Gemeinden und Grundstücke. Je nach Karte sind weitere Suchen verfügbar.
8. **Karteninhalt ändern -** Blenden sie Inhalte ein und aus, um die Karte ihren individuellen Bedürfnissen anzupassen.

9. **Drucken-** Karte als PDF ausdrucken.
10. **Karte abfragen -** Klicken sie einmal in die Karte, um Informationen zum Karteninhalt an dieser Stelle anzuzeigen. Resultatfenster kann mit der Maus verschoben werden.
11. **Koordinaten -** Fahren sie mit der Maus über die Karte, um hier Landeskoordinaten anzuzeigen. Geben sie eigene Koordinaten ein, um die Karte an gewünschten Ort zu zentrieren.
12. **Kartenmassstab-** Wählen sie einen Massstab aus der Liste, um den Kartenausschnitt anzupassen.
13. **Hinweisfenster -** wichtige Anmerkungen zur gewählten Karte werden hier angezeigt.

Hilfethemen

Elemente der Karte

- Kartengrösse ändern
- Vollbildmodus
- Hinweise auf Karte
- Karte wechseln

Navigation

- Basics
- Übersichtskarte
- Massstab wählen

Suchen

- Basics
- Standardangebot
- Koordinatensuche

Karteninhalt (Themen)

- Basics
- Detailinformationen (Metadaten)
- Hintergrundkarte

Drucken

Objektinformationen abfragen

- Basics
- Grundbuch-Eigentümer abfragen

Messen (Strecken und Flächen)

- Basics

Verwendungen

- Kartenbild abspeichern
- Link auf Karte versenden
- Kartenaufruf mit Parameter

Elemente der Karte

Kartengrösse ändern - Die Karte passt sich automatisch der aktuellen Grösse des Browserfensters an. Damit Karte vollständig dargestellt werden kann, muss das Browserfensters mindestens 980 x 840 Pixel gross sein. Aus technischen Gründen ist die maximale Kartenbreite auf ca. 1600 Pixel limitiert.
Vollbildmodus - Klicken sie auf die Lasche um die Seitenleiste (*Bild 1*) auszublenden und das Kartenfenster auf die ganze Bildschirmbreite auszuweiten. Ein erneuter Klick auf die Lasche blendet die Seitenleiste wieder ein.

Bild 1

Hinweise auf Karte (optional) - Wichtige Hinweise für das Kartenverständnis werden unten links auf der Karte eingeblendet.
Karte wechseln - Aus jeder Online-Karte haben sie einfachen Zugriff auf sämtliche andere Online-Karten. Klicken sie auf den Kartentitel (*Bild 2*) um eine Auswahlliste aller verfügbaren Karten anzuzeigen. Neue Karten

öffnen sich in einem neuen Browserfenster. Der aktuelle Raumausschnitt, der Kartenmassstab und die gewählte Hintergrundkarte werden dabei beibehalten.

Bild 2

Navigation

Basics - Prinzipiell funktioniert die Navigation durch unsere Karten so, wie sie es aus bekannten Angeboten wie Google Mapsoder Bing Maps kennen.

Um die **Karte zu vergrössern oder zu verkleinern** haben sie die folgenden Möglichkeiten:

- Mausrad verwenden
- Doppelklick in Karte (nur vergrössern)
- Pfeil auf Schieberegler verschieben oder Plus/Minus - Buttons benutzen (Bild 3)
- Plus / Minus - Tasten auf der Tastatur verwenden
- SHIFT-Taste gedrückt halten und Rechteck in Karte aufziehen (vergrössern)
- SHIFT und CTRL -Tasten gedrückt halten und Rechteck in Karte aufziehen (verkleinern)

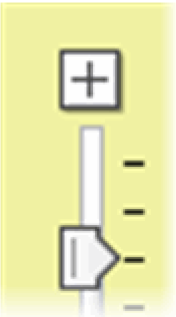


Bild 3

Karte verschieben

- Karte mit gehaltener Maustaste ziehen
- Pfeiltasten auf Tastatur verwenden

Übersichtskarte - Die Übersichtskarte oben rechts (Bild 4) passt sich dynamisch dem gewählten Kartenausschnitt an und bietet eine gute Orientierung der Umgebung der aktuellen Karte. Verschieben sie die rote Box, um den Kartenausschnitt in der Hauptkarte zu verändern.

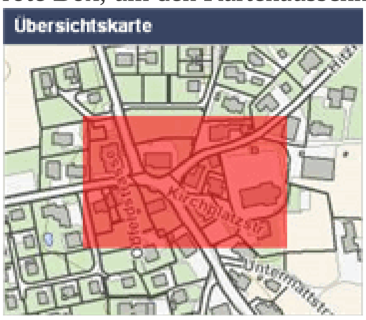


Bild 4

Kartenmassstab ändern - Der aktuelle Kartenmassstab wird unten links in der Fussleiste angezeigt (Bild 5). Über die Auswahlliste können sie direkt zu einem gewünschten Massstab springen. Folgende 13 Kartenmassstäbe stehen zur Verfügung.

Bild 5

1:250	1:3'000	1:25'000	1:350'000
1:500	1:5'000	1:50'000	
1:1'000	1:10'000	1:100'000	
1:2'000	1:17'500	1:200'000	

Aufgrund der vorgerechneten Hintergrundkarten werden andere Kartenmassstäbe nicht unterstützt.

Suchen

Basics - Suchmöglichkeiten finden sie in der Seitenleiste unter "Suchen". Wählen sie eine Suche aus der Liste (Bild 6) und füllen sie sämtliche Felder aus bevor sie mit einem Klick auf den Button die Suche auslösen. Unvollständige oder ungültige Eingaben ergeben eine Fehlermeldung. Das Resultat wird in der Karte automatisch zentriert und hervorgehoben.

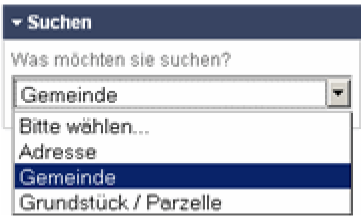


Bild 6

Standardangebot - Es stehen drei Suchmöglichkeiten zur Verfügung:

- Adresse: Suche nach Postadressen (die Adressen werden von Geopost zu Verfügung gestellt)
  Geopost
- Gemeinde: Finden sie jede der 87 Luzerner (Stand 2011)
  Liste aller Luzerner Gemeinden
- Grundstück / Parzelle: Finden sie Grundbuchparzellen der Amtlichen Vermessung
  Je nach Online-Karte sind weitere Suchen verfügbar.

Koordinatensuche - In den Koordinatenanzeigefeldern am unteren Bildrand (Bild 7) können sie eigene Koordinaten eingeben. Klicken sie danach auf den Pfeil-Button () um die Karte auf die eingegebenen Koordinaten zu zentrieren.

Bild 7

Karteninhalt (Themen)

Basics: Im Reiter "Karteninhalt" (Bild 8) auf der rechten Seite kann das Aussehen der Karte verändert und Karteninhalte (sog. "Themen") zu- bzw. weggeschaltet werden. Zusammengehörige Datensätze sind thematisch gruppiert und können als Gruppe ein- bzw. ausgeblendet werden. Grau hinterlegte Themen sind im aktuellen Kartenmassstab nicht sichtbar.

Bild 8

Zeichenerklärung:
Klicken um alle Themen einer Gruppe zu öffnen.
Klicken um alle Themen einer Gruppe zu schliessen.
Thema oder gesamte Gruppe nicht sichtbar. Klicken um Thema einzublenden.
Gruppe nur teilweise sichtbar. Klicken um alle Themen einzublenden.
Thema oder gesamte Gruppe sichtbar. Klicken um auszublenden.

Detailinformationen (Metadaten): Für viele Themen sind weiterführende Informationen (sog. Metadaten) verfügbar: Klicken sie den Infobutton () hinter dem Themennamen um die Metadaten in einem neuen Browserfenster anzuzeigen.

Hintergrundkarten: Unabhängig von den jeweiligen thematischen Inhalten, kann über die Buttons in der oberen rechten Kartenecke zwischen folgenden Hintergrundkarten gewechselt werden:

- **Grundbuchplan**: Zeigt Daten der Amtlichen Vermessung in der offiziellen Darstellung. Hinweis: Der gezeigte Grundbuchplan ist rechtlich nicht verbindlich und hat nur orientierende Wirkung. Monatliche Aktualisierung.
- **Basisplan**: Auf einer Auswahl der Daten der Amtlichen Vermessung aufgebauter farbiger Plan. Monatliche Aktualisierung.
- **Karte**: Zeigt die Schweizer Landeskarten (oberhalb Massstab 1:10'000) bzw. den Übersichtsplan der Amtlichen Vermessung (unterhalb 1:10'000). Karten sind schwarz-weiss, um guten Kontrast zu überlagernden Fachdaten zu gewähren. Aktualisierung nach Bedarf.
- **Luftbild**: Hochauflösendes Luftbild mit 25cm räumlicher Auflösung am Boden. Aktualisierung ca. alle 3 Jahre.

Inhalte der Hintergrundkarten können durch Nutzer nicht verändert werden.

Drucken

Im Reiter "Drucken" (Bild 9) können sie die angezeigte Karte als PDF-Dokument ausgeben. Der Vorgang kann einen Moment dauern. Nach der Fertigstellung wird ein Dialog geöffnet oder das PDF in einem neuen Fenster angezeigt (abhängig vom verwendeten Browser). **Stellen sie sicher, dass kein PopUp-Blocker aktiviert ist, da ansonsten der erstellte Ausdruck nicht anzeigt werden kann.**

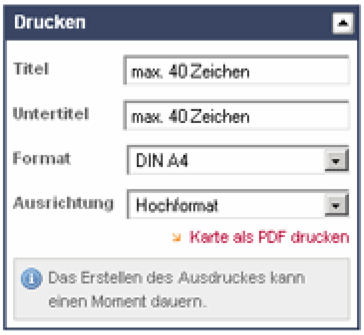


Bild 9

Die Druckfunktion bietet folgende Einstellungsmöglichkeiten:

- **Titel**: Haupttitel der Karte (Fettschrift). Maximal 40 Zeichen lang. Falls nichts eingegeben wird, wird ein Standardtitel gesetzt.
- **Untertitel**: Erscheint unterhalb des Haupttitels in kleinerer Schrift. Maximal 40 Zeichen lang.
- **Layout**: Wählen sie zwischen den Formaten A4 und A3 und den Ausrichtungen 'hoch' und 'quer'.

Beim Ausdrucken wird der aktuelle Kartenmassstab übernommen.

Objektinformationen abfragen

Basics:

- Grundsätzlich können zu den meisten Themen (unter "Karteninhalt" aufgeführte Themen) Sachinformationen abgefragt werden.
- Klicken sie an der gewünschten Stelle in die Karte (Abfrageort wird mit einem blauen Ausrufezeichen markiert), um Informationen in einem verschiebbaren Fenster (Bild 10) anzuzeigen.

- Informationen zu Parzellen/Grundstücke sind immer verfügbar. Flächenangaben werden in Hektaren, Aren und Quadratmeter angegeben.

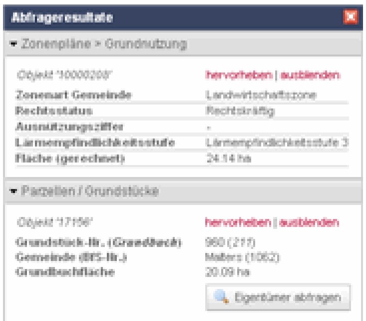


Bild 10

Eigentümer Grundbuch abfragen:

- Klicken sie in den Abfragresultaten auf "Parzellen/Grundstücke" und danach auf "Eigentümer anzeigen". Damit die Eingabemaske für die Eigentümerabfrage korrekt dargestellt werden kann, darf kein PopUp-Blocker aktiviert sein.

Messen (Strecken und Flächen)

Basics:

- Klicken sie oberhalb der Karte auf "messen", um das Messfenster zu öffnen (Bild 11). Während das Fenster geöffnet ist, kann die Karte nicht verschoben werden.
- Standardmässig ist "Strecke messen" angewählt. Um Flächen zu messen, bitte wechseln.

Bild 11

- Messvorgang mit einfachem Klick in Karte beginnen. Um Messresultat anzuzeigen (Bild 12), Messaktion mit Doppelklick abschliessen.

Bild 12

Verwendungen

Karte lokal abspeichern:
(folgt)

Karten-Link versenden:
(folgt)

Kartenaufruf mit Parametern:
Der Webadresse können beim Aufruf ein oder mehrere Parameter angehängt werden, um das Erscheinungsbild der Karte beim Start zu beeinflussen.

FOCUS: Start-Kartenausschnitt festlegen

Form: ?FOCUS=::
Anmerkungen: X und Y Werte müssen ganzzahlige, gültige Schweizer Landeskoordinaten sein. Es werden nur Massstäbe gemäss Tabelle oben unterstützt. Abweichende Werte werden auf den nächstliegenden Massstab gerundet.

Beispiel: http://www.geo.lu.ch/map/zonenplan/?FOCUS=665341:207748:2000
BASEMAP: Hintergrundkarte festlegen

Form: ?BASEMAP=B(asisplan) oder G(rundbuchplan) oder K(arte) oder L(uftbild)>

Beispiel: http://www.geo.lu.ch/map/zonenplan/?BASEMAP=L .

BFS: Eine oder mehrere Gemeinden hervorheben
Form: ?BFS=:: …
Anmerkung: Eine Liste der BfS-Nummern aller Gemeinden finden sie im GIS-Handbuch, siehe PDF-Link unten.
Beispiel: http://www.geo.lu.ch/map/zonenplan/?BFS=1056:1069:1068 .

PARCEL: Eine oder mehrere Grundbuchparzellen hervorheben
Form: PARCEL=. :

Anmerkung: Eine Liste aller Grundbuchperimeter finden sie im GIS-Handbuch, siehe PDF-Link unten. Grundbuchperimeter-Code und Parzellenummer werden in der Syntax durch einen Punkt getrennt. Werden mehrere Parzellen aufgerufen, müssen deren Wertepaare mit einem Doppelpunkt voneinander getrennt werden.
Beispiel: http://www.geo.lu.ch/map/zonenplan/?PARCEL=604.1319:604.2123:604.2227
Wo sinnvoll, können Parameter mit &-Zeichen miteinander kombiniert werden.
Beispiel: http://www.geo.lu.ch/map/zonenplan/?BASEMAP=B&PARCEL=204.666

Frequent gestellte Fragen (FAQ)

Ausdrucken
Ich habe eine Karte als PDF ausgedruckt. Warum ist ihr Massstab nicht genau?

- Stellen sie sicher, dass im Druckdialog ihres Druckers unter *Seiteneinstellungen > Seitenanpassung* die Einstellung "Keine" gewählt ist. Andernfalls kann es sein, dass das PDF beim Ausdruck in seinen Dimensionen verändert wird.

Karteninformationen abfragen
Es wird nichts angezeigt, wenn ich in den Abfrageresultaten auf "Eigentümer anzeigen" klicke.

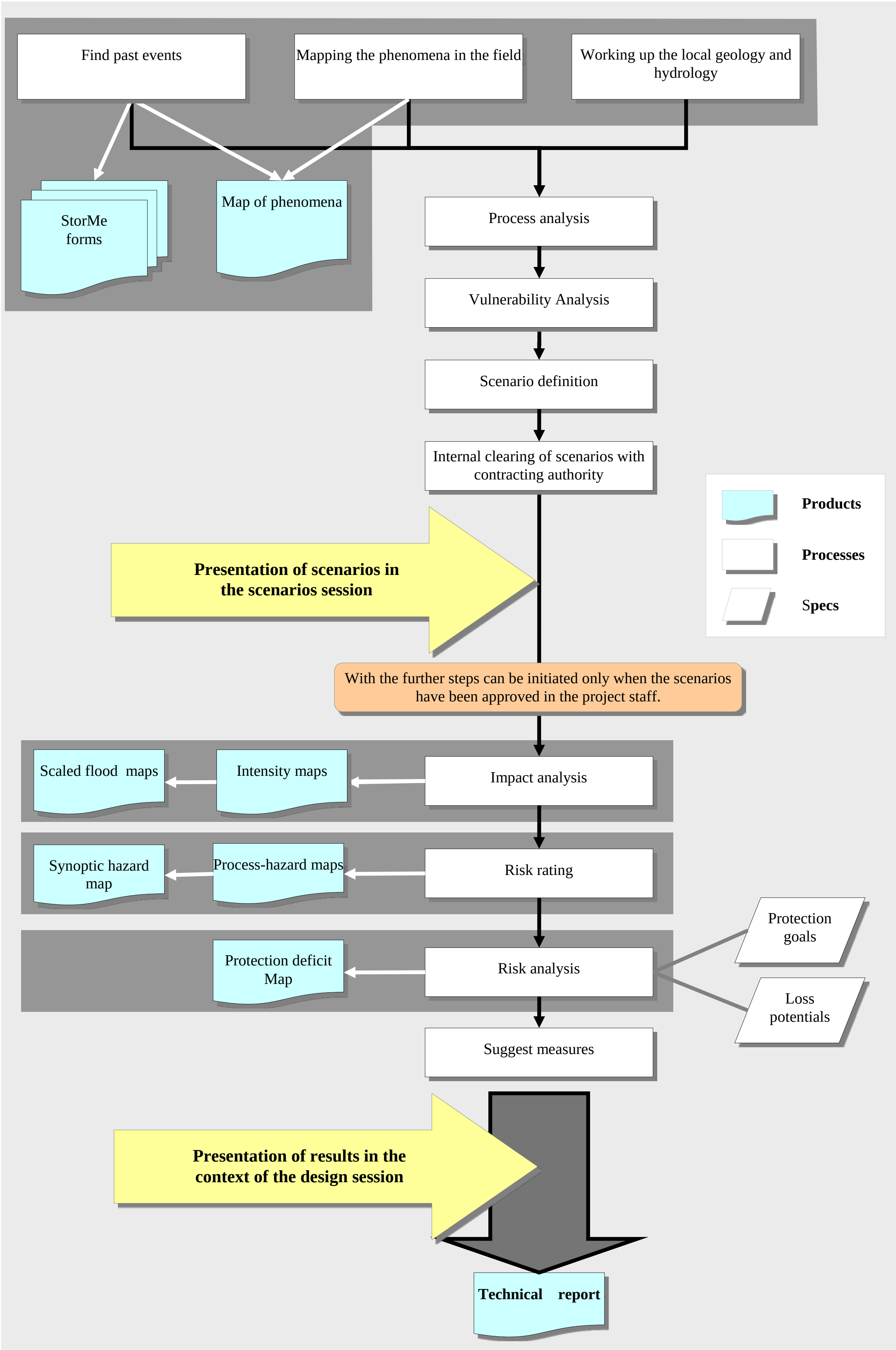
- Die Eigentümerinformationen werden in einem PopUp-Fenster angezeigt. Stellen sie sicher, dass ihr Browser für die Adresse www.geo.lu.ch PopUps zulässt.

Themen/ Karte anpassen
Warum bleibt die Karte unverändert nachdem die Sichtbarkeit eines Themas geändert wurde?

- Fast alle Themen sind massstabsabhängig und werden nur in einem bestimmten Massstabsbereich dargestellt. In grau dargestellte Themen sind im gegenwärtigen Kartenmassstab nicht sichtbar. Zommen sie in die Karte ein- oder aus um diese Themen zu sehen.
- Eventuell sind im gewählten Kartenausschnitt keine Daten sichtbar.

Appendix IV. Flow Diagram

Process of risk assessment



Appendix V. HazMap Technical Report ToC

Sample table of contents of the technical report

Introduction	Situation / problem statement
	Order
	Objective of
	Edited processes
	Project organization
Investigating perimeter	Choice of the perimeter
	Perimeter delineation
Description	Geology / geomorphology
Study area	Climate / rainfall
	Hydrology / hydrogeology
	Danger note card
	Event register
	Protection building cadastre
Procedure for the	Refurbishment of existing documents
Hazard assessment	Event - protection building cadastre and land registry
	Map of the phenomena
	Analysis of weak points
	Scenario training
	Methodology: water processes
	Methodology: landslide processes
	Methodology: fall processes
	Methodology: avalanche processes
Procedure for the	Hazard assessment and risk levels
Documentation of the results	Intensity maps
	Scaled flood map (optional)
	Process hazard maps
	Synoptic map of danger
	Risk analysis □Protection deficit cards
	Proposals for action
Risk assessment / results	Water processes
	Landslide processes
	Fall processes
	Avalanche processes
	Verified and added danger note card
Risk analysis	Damage potential
	Protection goals
	Protection deficit map
Proposals for action	General protective measures
	Measures for water processes
	Measures in case of landslides and debris flows
	Measures in case of stone / block shock
	Measures for avalanche processes
Concluding remarks	Implementation and application of the risk map
	Validity / stability of the risk map

Appendix VI. HazMap Tender Scope

გარემოს
ეროვნული სააგენტო
National Environmental
Agency

Sample template
Call for tenders for the development of a hazard map
(Developed for NEA based on sample from Luzern Canton, Switzerland)

Hazard Map of

[Name of the Municipality/Community/ies]

Call for tenders for the development of a hazard maps for the Municipality (Community/ies) of the [Municipality Name/Community/ies]

1 Scope of Work

Introduction

- Under the "hazard mapping" concept it is meant to undertake hazard assessment including development of hazard maps. The hazard assessment implies the assessment of the **effects of phenomena such as those related to water, landslides, rockfall and avalanche** on the settlement area and includes the following:

1 Process analysis, scenario building in the development and transit areas.

2 Process analysis, scenario building and elaborating hazards picture in possible impact areas.

- The national database for hazard events, maintained by NEA is the basis for this assessment [NEA webpage link], with the exception of debris flows and spontaneous landslides. The slopes with inclinations over 20 degrees and whose outlet areas are reaching the perimeter of the hazard map, should be taken into account in the hazard assessment and mapping. The national guidelines on geology and natural hazards developed by NEA are decisive guidance for the assessment [NEA webpage link].
- The study perimeter includes the built-up and prospective development areas and their environment. The exact study perimeter is to be set at the first meeting with the NEA and municipality stakeholders. The current zoning plans for the municipality [name of municipality] can be found webpage [insert relevant Ministry of Economy and Sustainable Development webpage link].

Task and performance description

- The hazard mapping work has to be conducted according to the guidelines for development of digital hazard maps in Georgia [NEA webpage link].

- Particular attention should be paid to the traceability and documentation of the hazard assessment: All scenarios that are based on the intensity and hazard categories are to be described in detail in the report or appendix. The tenderers are asked to propose details and additions to the project description, as far as they are required.
- For the flat to slightly inclined settlements with flat flooding, scaled flooding maps are to be drawn up according to the above-mentioned national guidelines.

Outputs to be produced

- The content and the quality of the outputs to be produced should be in compliance with the requirements in the national guidelines for developing digital hazard maps in Georgia. The following deliverables must be created in the scope of this contract:

Basics	Documentation	Plans
Event register (*)	Technical report	Intensity maps
Protection building cadastre	CD with digital data	Scaled flood maps
Map of phenomena including labelled vulnerabilities		Process hazard maps
		Synoptic map of hazard with verified hazard warnings
		Protection deficit map

(*) Include StorMe forms (appended to this Tender Scope) and all available files such as plans, photos, newspaper articles, memos, etc.

- Number of deliverables to submit:
  - 1 hardcopy for the concerned community
  - 1 hardcopy for the municipality
  - 1 hardcopy for the NEA
  - 1 digital copy for the NEA meeting all national guidelines for digital hazard mapping

Requests to the bidder/contractor

The bidder/contractor and its team must have proven expertise in the following areas:

- Overall project management for the development of a synoptic map of hazard
- Experience in hazard mapping with hydrological and geological methods
- Technical coordination
- Project management

Organization

Contracting Authority:	National Environmental Agency (NEA), MoE of Georgia
Beneficiary:	[Municipality Name] and [community name]

The project monitoring is carried out by a working group consisting of the representatives of NEA (lead agency) and the municipality. At least three meetings are foreseen, which are to prepared and conducted of the contractor:

- **Start-up meeting** with explanations about the project process including time schedule. The meeting serves for the clearance of the perimeter and for considering important information about past events, including contributions by qualified persons on the basis of their experience and their current (and former) function.
- **Scenarios meeting**: At this meeting the NEA and municipality is presented with scenarios by the contractor, based on which hazard map will be produced. Information would be provided concerning water hazards and discharges, debris and floating wood hazards, bottlenecks in the channels, etc. With respect to gravity and fall hazards to inform on breakout, transit and the deposit areas. The scenarios for gravity processes to be cleared in advance with NEA. NEA, municipality and community representatives will be given opportunity to ask questions and to make their own observations and assumptions.

  Note: no hazard areas would be presented during scenarios meeting, so that the discussed scenarios are not distorted by the considerations of the resulting effects hazard areas may have.
- **Design meeting** purpose is to present maps and the draft of the report. The NEA and municipality are provided with the report draft and are asked for comment. Their comments can be incorporated directly in the report or form the subject of a further meeting.

Timing and schedule

The offer would contain the work plan focusing on the following steps of the project:

- **Start-up meeting:** Project management / Contractor
- Create the event cadastre in collaboration with NEA and the Municipality
- Compilation of all baselines, mapping of the phenomena, calculations and modelling of processes, development of scenarios
- Internal presentation and professional clearances of the scenarios with the NEA project management
- **Scenario meeting:** Presentation and discussion of the scenarios (NEA and Municipality working group)
- Derivation of hazard maps and proposals for action
- Presentation and discussion of the designs (NEA project management)
- **Design meeting:** Presentation and discussion of the designs (NEA/Municipality working group and community representatives)
- Final clearances and delivery of the final results

2 Contract award procedure

Timetable for the award procedure

Invitation to bid	Date
Submission of bids	Date
Tender opening (not public)	Date

Evalkuaiton of tenders	Date
Award decision	Date
Starting work	Date

Eligibility criteria

- Proof of the availability of the resources and infrastructure for the implementing the contract in the field of hazard mapping (project management).
- Proof of the availability of the resources for the hazard mapping in the required areas of hydraulics, hydrology and Geology (expertise, methodology).
- References of the company on similar projects (hazard mapping).

The eligibility criteria will be answered Yes or No.
An incomplete or insufficient bid leads to the exclusion of the bid.

Award criteria

The following scoring is applied:

Bid price	30%
Methodology	30%
Qualification, experience and references of key personnel	40%

3 Documents to be submitted with the bid

The following documents should be submitted with the bid:

Enclosed bid completed and signed.
Bid security form and bid price per task breakdown including all taxes.
Methodology and work plan.
Bidder organisation chart with the name of the key personnel and their functions in the project
Staff list with the fee categories.
References of the key personnel and other staff involved in the project.
Other documents, considered necessary by the bidder.

Annex

Survey Forms for Hazard Events Database

[Director’s Signature]

National Environmental Agency / Date

Annex: Sample Survey Forms for StorMe[17] Database

Ereigniskataster Naturgefahren | ***Grunddaten*** | **Blatt 1/4**

Felder (MAXO-Code): M = Messwert, Feststellung A = Annahme, Schätzung X = Unklar, noch zu erheben O = nicht bestimmbar

Prozesstyp ○ Lawine ○ Sturz ○ Rutschung ○ Wasser / Murgang

Basisinformation

	Name	Nummer / Code	Weitere betroffene Gemeinden? Name	Nummer / Code
Gemeinde:				
Gewässer:	GEWISS-			
Forstkreis:				
Kantonsinterne Gebietseinteilung:				
Name spez. Prozessraum:				

○ **Einzelereignis** Datum: Zeitpunkt: Dauer: d h min

○ **Wiederkehrendes Ereignis** ○ täglich ○ wöchentlich ○ monatlich von Datum: bis Datum:

Oberster Punkt des Anriss-/Ausbruchsbereiches: X / Y = / Z = [m ü. M.]

Koordinaten des vordersten Ablagerungsrandes: X / Y = / Z = [m ü. M.]

X / Y = /

Erhebungsdatum:

Erhebung durch (Name, Adresse, Tel.):

Schäden

Mensch / Tiere

	# Tote	# Verletzte	# Evakuierte
Personen			
Tiere			

Sachwerte

	# zerstört	# beschädigt	Schadensumme [Fr.]
Wohnhäuser			
Industrie, Gewerbe, Hotel			
Landwirtschaftl. Ökonomiegebäude			
Öffentliche Gebäude und Infrastruktur			
Schutzbauten			
Andere (Beschreibung in Memo)			

Verbindungen / Infrastruktur

	verschüttet [m]	Unterbruch [Std.]	Schadensumme [Fr.]
Nationalstrassen			
Hauptstrassen			
Übrige Strassen			
Bahnlinien			
Transportanlagen, Masten			
Leitungen			
Andere (Beschreibung in Memo)			

Wald / Landwirtschaft

	betroff. Fläche [a]	Schadholzkub. [m³]	Schadensumme [Fr.]
Wald			
Landwirtschaftliche Nutzfläche			
Andere (Beschreibung in Memo)			

StorMe 2.0 **Kantonsinterne Nummer:** **Ereigniskatasternummer:**

[17] http://www.bafu.admin.ch/naturgefahren/14186/14801/16419/index.html?lang=de

Ereigniskataster Naturgefahren | **Grunddaten** | **Blatt 2/4**

Schäden *(Fortsetz.)*

Memo *(Beschreibung Schadenbild):*

(1) Räumungsarbeiten und –kosten, bewegte Kubaturen
(2) Aufteilung Schadensumme: Anteile privat / öffentlich
(3) Erstellte Verkehrsumleitungen
(4) Weitere
(5) Vorwarnungen publiziert
(6) Veranlasste Sofortmassnahmen

Raumplanung

Konflikt mit den momentan rechtsgültigen Nutzungs- und Gefahrenzonen? ☐

Betroffene Zonen? (Bau-, Camping-, Abbau-, Gefahrenzone, etc.): ....

Schutzbauten

Im Anriss-/Ausbruchbereich vorh.? ☐ Nr. Schutzbautenkataster: ______

Im Transitbereich vorhanden? ☐ Nr. Schutzbautenkataster: ______

Im Ablagerungsbereich vorhanden? ☐ Nr. Schutzbautenkataster: ______

Memo *(Beschreibung Schutztauglichkeit und Massnahmen):*

(1) Art / Typ der Schutzbauten
(2) Zustand der Bauten, Beurteilung der Schutztauglichkeit
(3) Verbleibende / neue Gefahren
(4) Kosten Reparaturen / Ergänzungsbauten
(5) Weitere

Dokumentation

Name, Adresse Dokumentationsstelle / Bezeichnung, Nummer der Studie, Bilder, etc.

☐ Notiz, Studie, Gutachten, Berechnungen ______

☐ Zeitungen, Literatur, Historische Quellen ______

☐ Fotodokumentation ______

☐ Orthofotos, Luftbilder ______

☐ Video, Film ______

☐ Meteodaten ______

Kartierung

Prozessraum kartiert? ☐

Methodik

Anriss-/Ausbruchsbereich:	Ablagerungsbereich:
☐ An Ort und Stelle	☐ An Ort und Stelle
☐ Luftbilder, Fotos	☐ Luftbilder, Fotos
☐ Fernbeobachtung (vom Gegenhang)	☐ Fernbeobachtung (vom Gegenhang)
☐ Andere bzw. retrospektive Erhebung	☐ Andere bzw. retrospektive Erhebung

StorMe 2.0 **Kantonsinterne Nummer:** ______ **Ereigniskatasternummer:** ______

Ereigniskataster Naturgefahren **Lawine** **Blatt 3/4**

☐ Felder (MAXO-Code): M = Messwert, Feststellung A = Annahme, Schätzung X = Unklar, noch zu erheben O = nicht bestimmbar

Prozessart

○ Fliesslawine ○ Staublawine ○ Fliess- und Staublawine gemischt

⇨ Zusätzlich Fragebogen D „Lawinen mit Sach- und/oder Personenschäden" des SLF ausgefüllt? ☐

Ursachen Meteo

Wind

☐ ☐ Stärke [m/s]

☐ ☐ Richtung [Grad]

Schneezuwachs

☐ ☐ Innerhalb 24 h [cm]

☐ ☐ Innerhalb 72 h [cm]

☐ Schneeschmelze ☐ Nicht bestimmbar

Auslösung

Qualifikation Auslösung: ☐

○ Spontan ○ Sprengung ○ Ski / Snowboard ○ Andere (Beschreibung in Memo)

Anrissbereich

Anrissbereich im Wald ? ☐

Anrissmächtigkeit: ☐ ☐ [m]

Anrissbreite: ☐ ☐ [m]

Exposition: ☐ ☐

Gleitfläche: ☐ ○ Innerhalb Schneedecke ○ Auf dem Boden

Ablagerungsbereich

Ablagerungsbereich im Wald ? ☐

Maximale Ablagerungsmächtigkeit: ☐ ☐ [m]

Maximale Ablagerungsbreite: ☐ ☐ [m]

Ablagerungskubatur: ☐ ☐ [m³]

Schneequalität: ○ trocken ○ feucht, nass

Memo (Ereignis-Beschreibung zu den Stichworten):

(1) Topographie Einzugsgebiet, Transit-, Ablagerungsbereich
(2) Meteorologie: Lokale Vorgeschichte (Entwicklung und Aufbau der Schneedecke)
(3) Ergänzende Meteorologie (Nullgradgrenze, Niederschläge, Schneeschmelze, Windverhältnisse)
(4) Zustand des Waldes
(5) Vergleich zu früheren Ereignissen, Abschätzung der Schadenwirkung
(6) Weitere

StorMe 2.0 **Kantonsinterne Nummer:** ☐ **Ereigniskatasternummer:** ☐

Ereigniskataster Naturgefahren — **Sturz** — **Blatt 3/4**

Felder (MAXO-Code): M = Messwert, Feststellung A = Annahme, Schätzung X = Unklar, noch zu erheben O = nicht bestimmbar

Prozessart

- ○ Steinschlag (Steine < 0.5 m)
- ○ Blockschlag (Blöcke 0.5 – 2 m)
- ○ Felssturz (Grossblöcke > 2 m)
- ○ Bergsturz
- ○ Eissturz

Ursachen Meteo

Gewitter
- Dauer [Std.]
- Niederschlags-menge [mm]

Dauerregen
- Dauer [Std.]
- Niederschlags-menge [mm]

☐ Schneeschmelze ☐ Nicht bestimmbar

Auslösung

Qualifikation Auslösung:

Natürlich durch:
- ○ Allgemein
- ○ Rutschung / Erosion
- ○ Erdbeben

- ○ Künstlich (Beschreibung in Memo)
- ○ Andere (Beschreibung in Memo)

Ausbruchbereich

Ausbruch aus:
- ○ Felswand
- ○ Gehängeschutt
- ○ Gletscher

Anzahl Blöcke:

Ausbruchkubatur: [m³]

Transitbereich

Untergrund:	Gehängeschutt	Wald	Weide, Wiese
Abschnittslänge:	[m]	[m]	[m]

Ablagerungsbereich

Gesamtkubatur: [m³]

Steine, Blöcke, Grossblöcke: ○ 1 ○ 2-10 ○ 11-50 ○ > 50

Kubatur des grössten Blockes: [m³]

Memo (Ereignis-Beschreibung zu den Stichworten):

(1) Ausbruchgebiet: Allgemeine Beschreibung, Felsqualität
(2) Beschreibung des Waldzustandes
(3) Naturschaden im Transitbereich
(4) Angaben zu Sprunghöhen (Schlagspuren an Bäumen)
(5) Vorgeschichte, Ergänzende Meteorologie (Nullgradgrenze, Niederschläge, Schneeschmelze)
(6) Vergleich zu früheren Ereignissen, Abschätzung der Schadenwirkung
(7) Weitere

StorMe 2.0 Kantonsinterne Nummer: Ereigniskatasternummer:

Ereigniskataster Naturgefahren ***Wasser / Murgang*** **Blatt 3/4**

☐ **Felder (MAXO-Code): M = Messwert, Feststellung A = Annahme, Schätzung X = Unklar, noch zu erheben O = nicht bestimmbar**

Prozessart

○ Überschwemmung / Hochwasser ○ Murgang (in Gerinne)

⇨ Daten an Landeshydrologie und –geologie, Datenbank „Solids-II", weitergeleitet? ☐

Weitere beteiligte Prozesse (von untergeordneter Bedeutung):

☐ Überschwemmung ☐ Murgang (in Gerinne) ☐ Erosion (Ufer, Böschung) ☐ Andere (Beschreibung in Memo)

☐ Übersarung ☐ Rutschung ☐ Sturz

Ursachen Meteo

☐ Schneeschmelze ☐ Nicht bestimmbar

Gewitter

☐ ☐ Dauer [Std.]

☐ ☐ Niederschlags-menge [mm]

Dauerregen

☐ ☐ Dauer [Std.]

☐ ☐ Niederschlags-menge [mm]

Auslösung

Qualifikation Auslösung: ☐

☐ Verklausung durch Schwemmholz

☐ Verklausung durch Geschiebe

☐ Verklausung bei Brücke / Durchlass

☐ Anderes Engnis

☐ Ausuferung/Ausbruch wegen zu kleiner Gerinnegeometrie

☐ Dammbruch

☐ Überlastung der Kanalisation

☐ Andere (Beschreibung in Memo)

Bewertung der Gerinneprozesse

	gross	mittel	gering
Seitenerosion (Ufer, Böschung)	○	○	○
Tiefenerosion	○	○	○
Auflandung der Sohle	○	○	○

	gross	mittel	gering
Murgangablagerung im Gerinne	○	○	○
Schwemmholzablagerung im Gerinne	○	○	○

Überschwemmungs- / Ablagerungsbereich

Kubatur abgelagerte Feststoffe: ☐ ☐ [m³]

Murgangkubatur: ☐ ☐ [m³]

Kubatur abgel. Schwemmholz: ☐ ☐ [m³]

Maximalabfluss Q_{max}: ☐ ☐ [m³/s] (Messstelle auf Blatt 4/4 kartieren)

Mittl. Ablagerungsmächtigkeit der Feststoffe: ☐ ☐ [m]

Mittlere Überschwemmungstiefe: ☐ ☐ [m]

Max. Ablagerungsmächtigkeit der Murköpfe: ☐ ☐ [m]

Memo *(Ereignis-Beschreibung zu den Stichworten):*

(1) Messstelle Q_{max}

(2) Allgemeiner Prozessmechanismus, Berechnungs- und Schätzmethoden

(3) Zustand / Beurteilung vorhandener Geschiebesammler

(4) Vorgeschichte (nass, mittel, trocken, Frost) / Ergänzende Meteo (Nullgradgrenze, Hagelwetter, etc.)

(5) Hochwasserspuren (wo, wie hoch)

(6) Vergleich zu früheren Ereignissen, Abschätzung der Schadenwirkung

(7) Weitere

StorMe 2.0 **Kantonsinterne Nummer:** ☐ **Ereigniskatasternummer:** ☐

Ereigniskataster Naturgefahren | ***Rutschung*** | **Blatt 3/4**

☐ **Felder (MAXO-Code): M = Messwert, Feststellung A = Annahme, Schätzung X = Unklar, noch zu erheben O = nicht bestimmbar**

Prozessart

○ Rutschung ○ Hangmure ○ Absenkung und Einsturz

Weitere beteiligte Prozesse (von untergeordneter Bedeutung):

☐ Überschwemmung ☐ Murgang (in Gerinne) ☐ Erosion (Ufer, Böschung) ☐ Andere (Beschreibung in Memo)
☐ Übersarung ☐ Rutschung ☐ Sturz

Ursachen Meteo

Gewitter
☐ ☐ Dauer [Std.]
☐ ☐ Niederschlags-menge [mm]

Dauerregen
☐ ☐ Dauer [Std.]
☐ ☐ Niederschlags-menge [mm]

☐ Schneeschmelze ☐ Nicht bestimmbar

Auslösung

Qualifikation Auslösung: ☐

○ Natürlich ○ Künstlich, aufgrund menschlicher Tätigkeit
○ Durch Gerinneerosion ○ Andere (Beschreibung in Memo)

Ausbruch- / Ablösungsbereich

Anrissmächtigkeit: ☐ ☐ [m] Absenktiefe: ☐ ☐ [m] Rutschkörper: Einsturzmasse: ☐ ○ Fels ○ Lockermaterial

Anrissbreite: ☐ ☐ [m] Anrissfläche: Einsturzfläche: ☐ ☐ [m²] Gleitfläche: ☐ ○ auf Fels ○ im Lockermaterial

Transit- / Ablagerungsbereich

Ablagerungsmächtigkeit im Staubereich: ☐ ☐ [m]
Bewegte Kubatur: ☐ ☐ [m³]
Übergang der Rutschung in Hangmure (Rüfe)? ☐
Ablagerung im Gerinne? ☐ ☐
Wenn JA, Gerinnerückstau? ☐

Tiefe der Gleitfläche: (Gründigkeit) ☐ ○ 0 – 2 m (flachgründig) ○ 2 – 10 m (mittelgründig) ○ > 10 m (tiefgründig)

Geschwindigkeit: ☐ ○ Aktiv (> 10 cm/a) ○ Langsam (2 – 10 cm/a) ○ Substabil, sehr langsam (< 2 cm/a)

Memo *(Ereignis-Beschreibung zu den Stichworten):*

(1) Wasseraustritte, Allgemeiner Prozessmechanismus
(2) Falls künstliche Auslösung: Nähere Beschreibung der auslösenden Prozesse
(3) Hydrologische Verhältnisse im Einzugsgebiet
(4) Vorgeschichte (nass, mittel, trocken, Frost)
(5) Ergänzende Meteorologie (Nullgradgrenze, Niederschläge, Schneeschmelze)
(6) Vergleich zu früheren Ereignissen, Abschätzung der Schadenwirkung
(7) Weitere

StorMe 2.0 **Kantonsinterne Nummer:** ☐ **Ereigniskatasternummer:** ☐

Ereigniskataster Naturgefahren	***Kartierung***	**Blatt 4/4**

Ereignis: Gemeinde: ____________________ Prozesstyp: ______________ **Digitalisierung** erfolgt? ☐

Kartierung: Massstab 1 : __________ Datum: ☐.☐.☐ Name, Adresse, Tel.: ______________________

StorMe 2.0	**Kantonsinterne Nummer:**		**Ereigniskatasternummer:**	

Appendix VII. Study ToR

CONSOLIDATION OF THE HAZARD MAPPING METHODOLOGY DEVELOPED BY THE NATIONAL ENVIRONMENTAL AGENCY WITHIN THE SCO DRR PROJECT AND ASSESSMENT OF THE LEGAL FRAMEWORK FOR ITS APPLICATION

Duration: (15 July, 2016 – 22 November, 2016)

1. BACKGROUND

Georgia is characterized by high frequency and risk levels of disasters that hinder the country's sustainable development and poverty reduction efforts and pose significant threat to different sectors of economy as well as human development. The country lacks a long-term preventive planning and prioritization at national, regional and local levels.

While DRR is gradually becoming one of the key priorities for the Government of Georgia (GoG), and there has been an obvious progress in addressing prevention issues, yet DRR related legislation is more response and recovery rather than prevention and mitigation oriented. GoG recognizes the need for support to enhance the national DRR system in order to overcome its capacity gaps, particularly in terms of prevention and risk reduction. Currently, national, regional and local development planning is not consistently informed by multi-hazard risk assessment and a unified hazard mapping methodology is missing

As the experience of developed countries demonstrates, In order to systematically address prevention needs a unified hazard mapping methodology regulated through a dedicated legal framework needs to be developed and introduced. Hazard data collection and mapping is being conducted mainly in a project-based manner.

Decision-makers at central and local levels seem to need improved understanding of hazard and risk concepts and their application. Roles and responsibilities of national institutions on hazard mapping and risk assessment are not clear. Different institutions like the National Environmental Agency (NEA), the Institute of Earth Science - Seismic Monitoring Centre of the Ilia State University, the Institute of Geophysics are mandated to collect, analyse and disseminate data and information on natural hazards in Georgia.

The Emergency Management Agency (EMA) of the Ministry of Internal Affairs receives hazard maps from NEA, and seismic hazard maps from the Institute of Geophysics in order to develop GIS risk maps based on the cadastre maps from the State Registry of the Ministry of Justice. However, scale and quality of the maps are unclear.

2. HAZARD MAPPING METHODOLOGY

The Swiss Cooperation Office (SCO) has a long standing cooperation with the GoG in the field of DRR on local, regional and central levels. Within its Prevention and Preparedness Project in direct cooperation with the Ministry of Environment Protection and Natural Resources and the Ministry of Internal Affairs methodologies of hazard mapping and of DRR cost benefit analysis were developed. Both methodologies build on the knowledge and experience of Switzerland. However, they were adapted by Georgian specialists according to the local needs and available data.

With the developed hazard mapping methodology specialists of Department of Hydrometeorology and Department of Geological Hazards and Geological Environment Management of NEA have created landslide, stone fall, mudflow, flood and avalanche hazard maps for 6 communities in Mestia municipality. In order to raise awareness among the responsible ministries and legislators concerning the importance of the development of hazard maps and its legal frame NEA has organized a presentation of the methodology for high level government officials, MPs and donor community representatives.

The SCO plans to continue supporting GoG in the fields of Climate Change Adaptation and Disaster Risk Reduction in the frame the new Swiss Cooperation Strategy 2017-2020, based on the achievements of the current DRR program, especially in elaborating a formally accepted /approved hazard mapping methodology and the required legal frame for its application.

For this reason an external study shall be conducted to analyse the work done by the NEA specialists for the elaboration of the methodology to date for its further consolidation and to analyse the existing legal frame in Georgia relevant for an application of the Hazard Mapping methodology.

3. OBJECTIVES OF THE study

The study will focus on two aspects of the Hazard Mapping Methodology.

From the technical side the objective of the study is to consolidate the Hazard Mapping Methodology developed by the NEA specialists, to discover existing gaps and define improvement needs in order to allow a cohesive approach between the specialists of geology and hydrology.

From the legal perspective the goal of the study is to undertake a comprehensive review of current (and draft if applicable) legislation related to hazard mapping. Provide recommendations on general procedure for setting up a comprehensive system and legal framework for the application of Hazard Mapping at all at all governmental levels

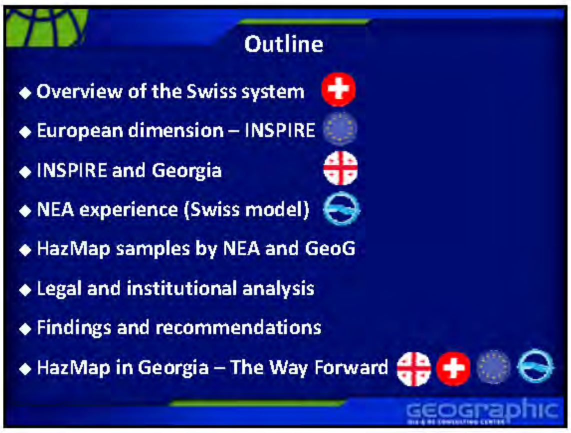
4. DELIVERABLES / REPORTING

Outputs of the mission will be:

1. Detailed work plan with the description of the process, the methodology to be used, the data required, and a timeframe to accomplish the assignment (two weeks);
2. Report on the assessment of the Hazard Mapping Methodology (by end of month 2);
3. Recommendations on development of general procedure for setting up a comprehensive system and legal framework for the application of Hazard Mapping at all governmental levels (by end of month 2);
4. Presentation and agreement of the findings and recommendations with the stakeholders (by end of month 3)
5. Final report describing process and deliverables achieved (by end of month 4)

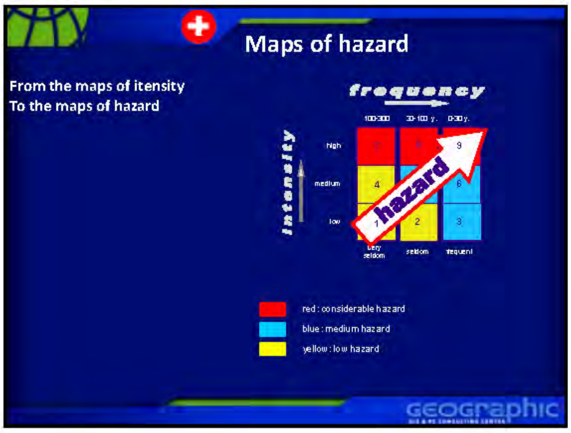
Appendix VIII. CMF-2016 Presentation

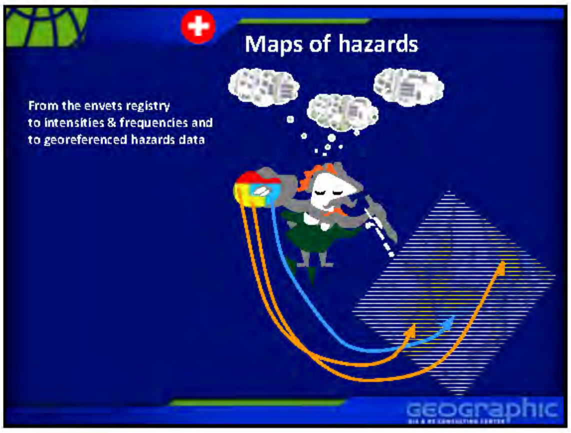

SDC SCO NEA DRR Project in Georgia
Consolidation of the HAZard MAPping Methodology & Assessment of the Legal Framework for its Application
HAZMAP Review - The Way Forward
29 November 2016 Tbilisi GE
Caucasus Mountain Forum
National Environmental Agency
GEOGRAPHIC and K&J law Firm
GEOGRAPHIC

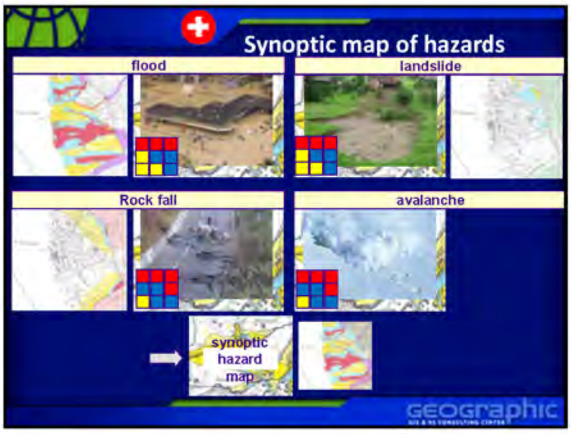

Outline
◆ Overview of the Swiss system
◆ European dimension – INSPIRE
◆ INSPIRE and Georgia
◆ NEA experience (Swiss model)
◆ HazMap samples by NEA and GeoG
◆ Legal and institutional analysis
◆ Findings and recommendations
◆ HazMap in Georgia – The Way Forward
GEOGRAPHIC


Our Team:
http://geographic.ge
George Gotsiridze (Team Leader and Expert in Geomorphology/Geo-Ecology, Director)
Malkhaz Khurtsidze (Land Management Specialist/Cartographer)
Mamuka Gvilava (Project Manager and Environmental Expert)
Tamar Bakuradze (Environmental Expert/Cartographer)
Tinatin Janelidze (GIS Expert/Cartographer)
Yuri Kolesnikov (GIS and DB Manager)
Rezi Kenia, GIS Server Administration
Irina Vartanova (Programmer)
Ekaterine Khokhiashvili (GIS Specialist)
http://kjlaw.ge
David Pataraia (Partner)
Irakli Kordzakhia (Partner)
Nino Saselia (Senior Associate)
Support and cooperation: SDC/SCO, NEA
GEOGRAPHIC


Maps of intensity
3 maps of intensity for each 4 processes
- floods
- landslides
- rock falls
- avalanches
frequency
Intensity
high
medium
low
hazard
very seldom
seldom
frequent
GEOGRAPHIC


Maps of hazard
From the maps of itensity
To the maps of hazard
frequency
Intensity
high
medium
low
hazard
very seldom
seldom
frequent
red : considerable hazard
blue : medium hazard
yellow : low hazard
GEOGRAPHIC

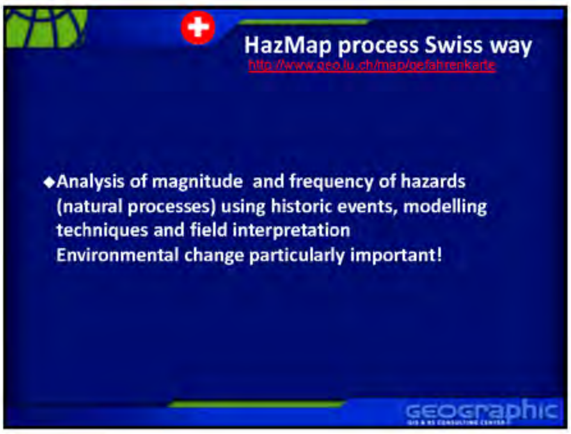

Maps of hazards
From the envets registry
to intensities & frequencies and
to georeferenced hazards data
GEOGRAPHIC



Synoptic map of hazards
flood
landslide
Rock fall
avalanche
synoptic hazard map
GEOGRAPHIC

'Swiss' hazard mapping
red zone
high risk for constructions and people inside houses
• no new constructions/reconstruction allowed
blue zone
medium risk
• constructions allowed with restrictions
yellow zone
low risk
• information for the ground-owners
GEOGRAPHIC

HazMap into land-use plan
considerable hazard
construction of new buildings prohibited
medium hazard
construction only allowed with restrictions
low hazard
local protection recommended
GEOGRAPHIC



HazMap process Swiss way
http://www.geo.lu.ch/map/gefahrenkarte
◆Analysis of magnitude and frequency of hazards (natural processes) using historic events, modelling techniques and field interpretation
Environmental change particularly important!
GEOGRAPHIC

Risk assessment
accepted risk
not accepted risk
Intensity
Frequency
hiking trails, farm tracks, pastures
Uninhabited buildings, roads of local impact, protection forest, cultivated land
Single inhabited buildings, roads of superior impact, railway tracks
Settlement areas
GEOGRAPHIC

Disaster risk management
Avoid hazards
Mitigate impact or adverse effects
Respond to adverse effects
Transfer risks
Preventive measures:
Carry the risks
◆ Analysis of economic, social and physical vulnerability using exposure, susceptibility and value of elements at risk.
◆ Analysis of existing coping mechanisms including structural and non-structural measures, early warning systems and emergency preparedness.
◆ Estimating and visualizing existing and future risks.
GEOGRAPHIC

HazMap: EU dimension

- INSPIRE Directive 2007/2/EC establishing INfrastructure for SPatial InfoRrmation in the European Community = = EU Spatial Data Infrastructure
- Annexes I, II and III with 9 + 4 + 21 = 34 themes
  http://inspire.ec.europa.eu/data-specifications/2892
- Theme Data Specifications, including *Nature Risk Zones*
  http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_NZ_v3.0.pdf

<u>Risk</u> = <u>Hazard</u> x <u>Exposure</u> x <u>Vulnerability</u> <u>R</u>=<u>H</u>*<u>E</u>*<u>V</u>

HazMap: EU methodology

INSPIRE risk zone concept

INSPIRE styles for hazard mapping

INSPIRE and Georgia

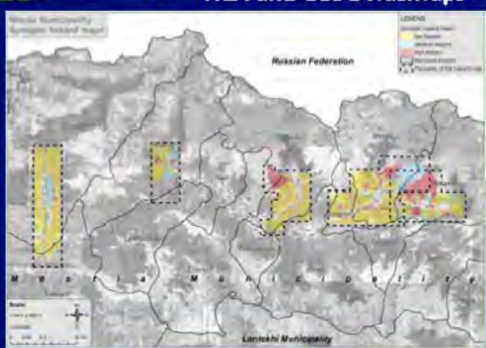
- GoG Resolution No. 262 of 2013 sets NAPR to lead NSDI
  http://nsdi.gov.ge
- GoG 262/2013 article 3 asks NAPR implement INSPIRE
  http://nsdi.gov.ge/en/Maps
- GoG Resolution 502 of 2014 sets NEA data pricing model

NEA's HazMap experience

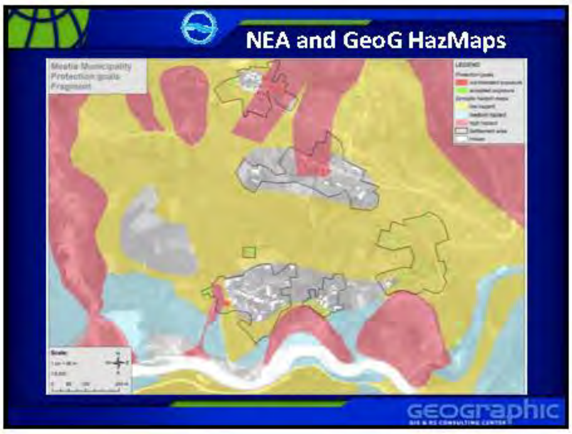
- Event register
- Protection facility cadastre
- Map of the phenomena
- Intensity maps
- Hazard frequency
- Hazard assessment
- Scaled flood maps
- Process hazard maps
- Synoptic hazard map
- Verified risk note maps
- Protection deficit maps
- Proposals for action
- Dossier

NEA and GeoG HazMaps

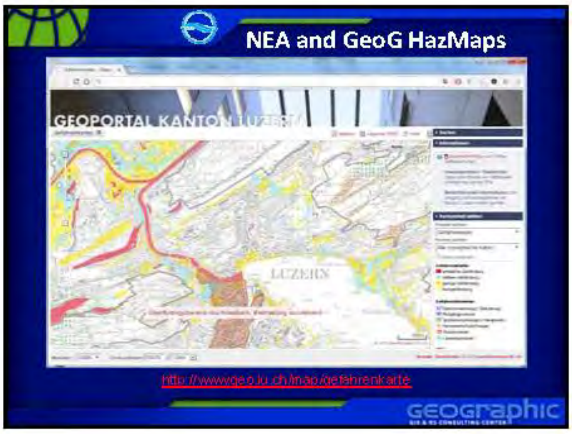
NEA and GeoG HazMaps

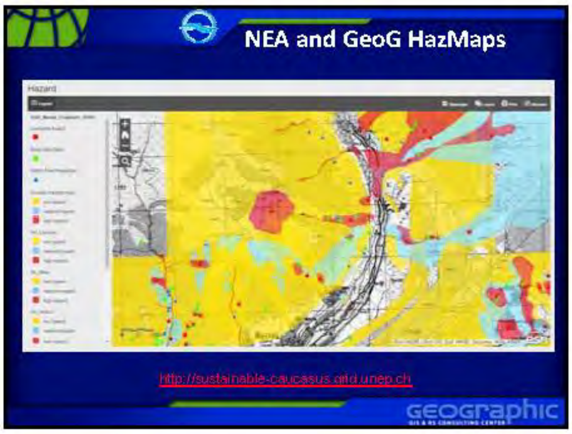


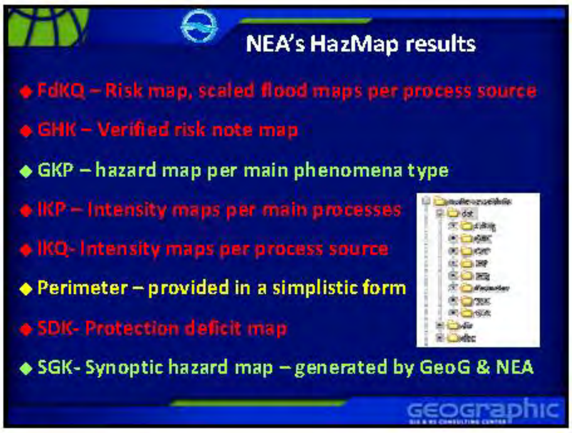

NEA and GeoG HazMaps
Mestia Municipality
Synoptic hazard maps
Fragment
GEOGraphic


NEA and GeoG HazMaps
Mestia Municipality
Protection goals
Fragment
GEOGraphic


NEA and GeoG HazMaps
Mestia Municipality
Synoptic hazard maps
GEOGraphic

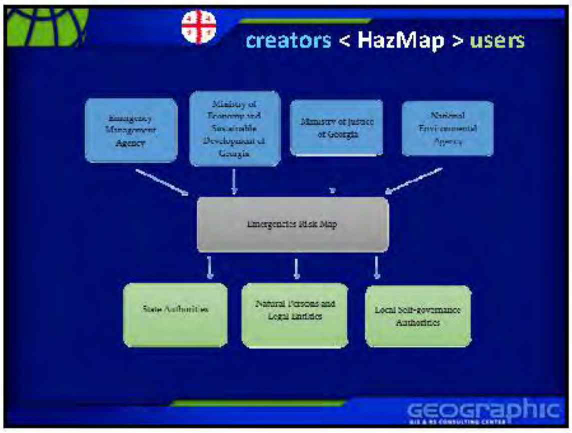

NEA and GeoG HazMaps
GEOPORTAL KANTON LUZERN
LUZERN
http://www.geo.lu.ch/map/gefahrenkarte
GEOGraphic


NEA and GeoG HazMaps
Hazard
http://sustainable-caucasus.grid.unep.ch
GEOGraphic

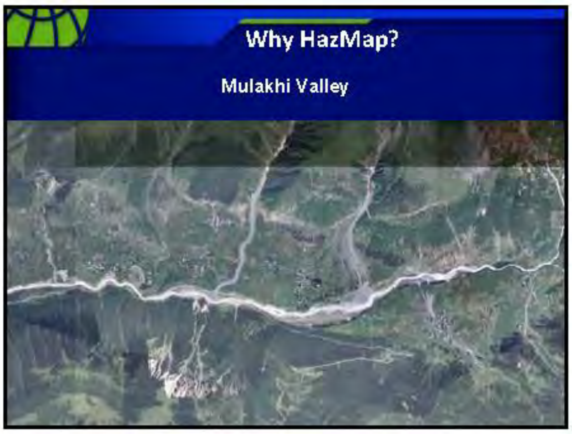

NEA's HazMap results
◆ FdKQ – Risk map, scaled flood maps per process source
◆ GHK – Verified risk note map
◆ GKP – hazard map per main phenomena type
◆ IKP – Intensity maps per main processes
◆ IKQ- Intensity maps per process source
◆ Perimeter – provided in a simplistic form
◆ SDK- Protection deficit map
◆ SGK- Synoptic hazard map – generated by GeoG & NEA
GEOGraphic


Applicable legal acts
International Commitments
Implementation of International Commitments
Domestic Acts
Association Agreement between the European Union and the European Atomic Energy Community and their Member States of the one part, and Georgia, of the other part entered into force on July 1, 2016
1. Resolution #262 of the Government of Georgia, dated October 9, 2013 on Setting up the Governmental Commission for the Creation and Development of Spatial Data Infrastructure
2. National Action Plan for the Implementation of the Association Agenda between Georgia and the European Union (approved annually by a governmental decree)

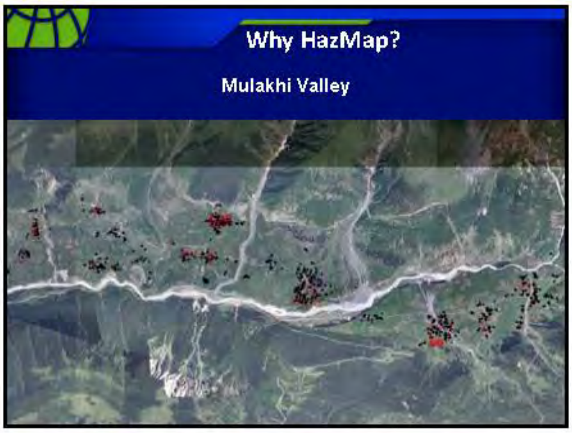

Authorised GoG agencies
National and Civil Security
Environmental Protection
Integration of Digital Bases and Maps

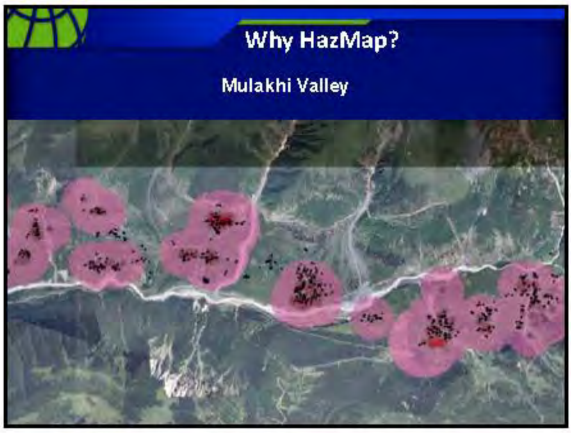

creators < HazMap > users
Emergency Management Agency
Ministry of Economy and Sustainable Development of Georgia
Ministry of Justice of Georgia
National Environmental Agency
Emergencies Risk Map
State Authorities
Natural Persons and Legal Entities
Local Self-governance Authorities

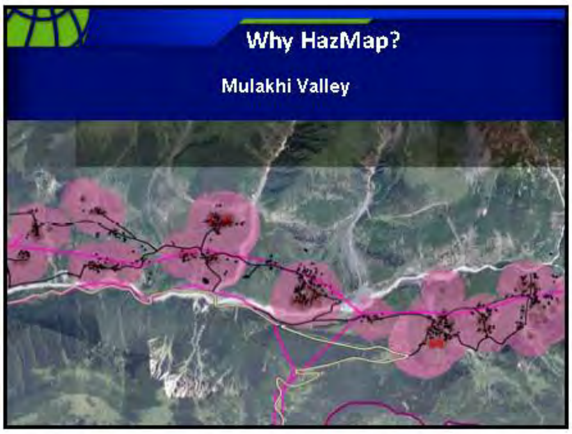

Why HazMap?
Mulakhi Valley

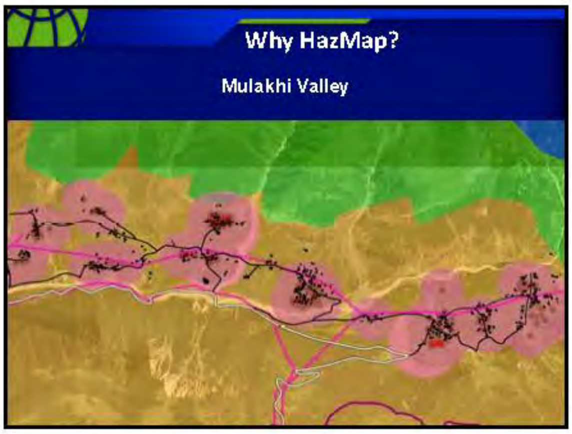

Why HazMap?
Mulakhi Valley

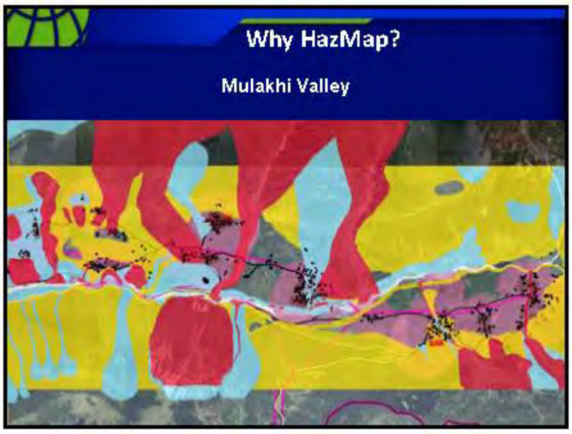

Why HazMap?
Mulakhi Valley


Why HazMap?
Mulakhi Valley


Why HazMap?
Mulakhi Valley


Why HazMap?
Mulakhi Valley


Why HazMap?
Mulakhi Valley


Why HazMap?
Mulakhi Valley

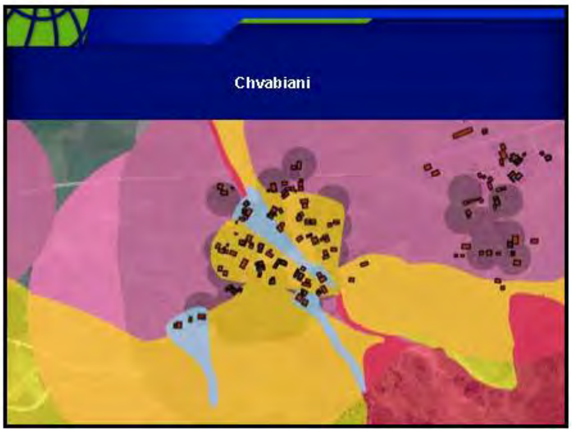

Why HazMap?


Why HazMap?
Chvabiani
GEOGraphic


Chvabiani


Chvabiani


Chvabiani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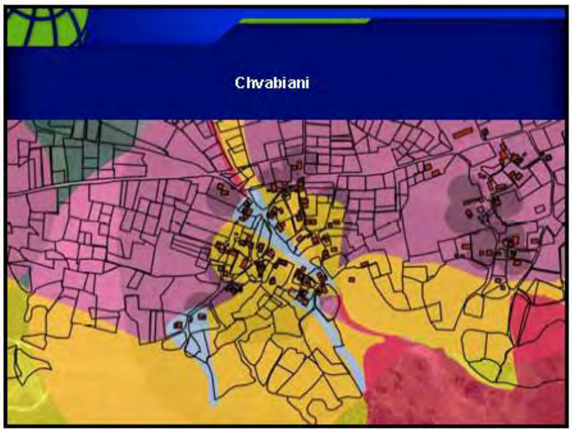
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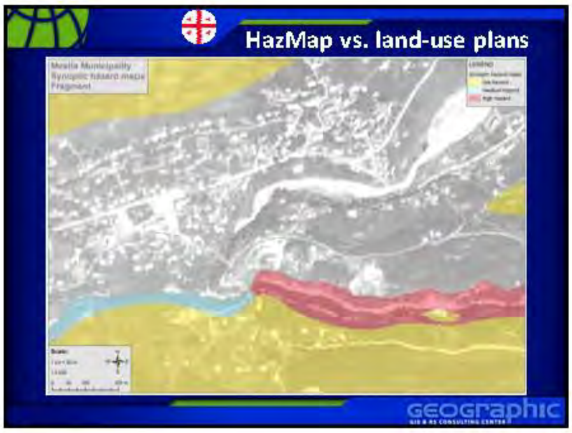
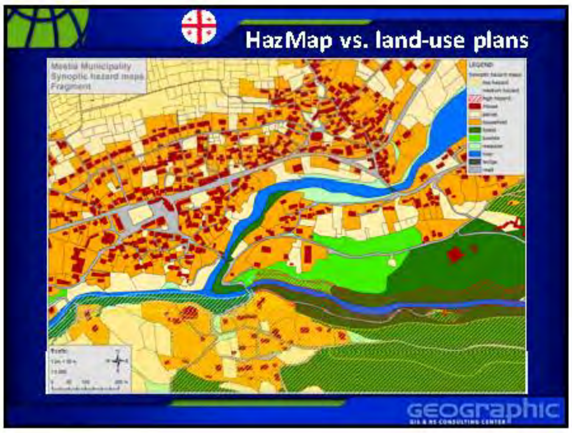

HazMap vs. land-use plans
Mestia Municipality
Synoptic hazard maps
Fragment
GEOGRAPHIC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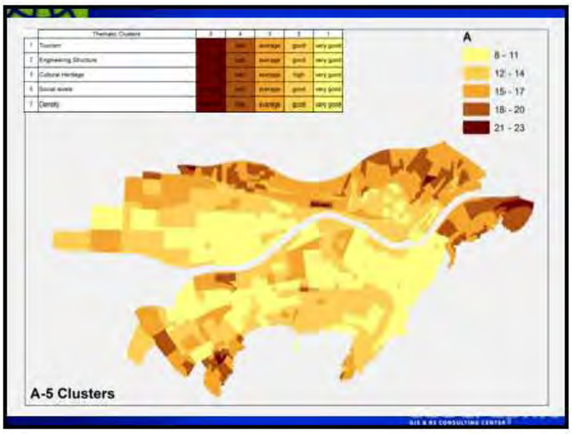
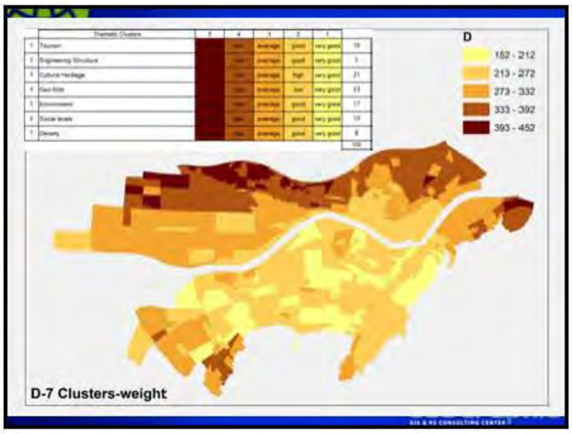
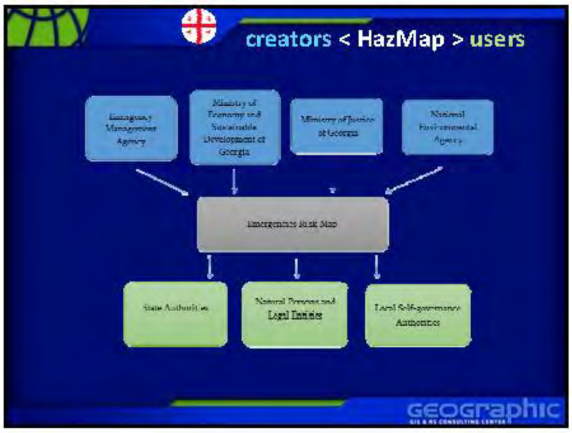

A
8 - 11
12 - 14
15 - 17
18 - 20
21 - 23
A-5 Clusters


D
152 - 212
213 - 272
273 - 332
333 - 392
393 - 452
D-7 Clusters-weight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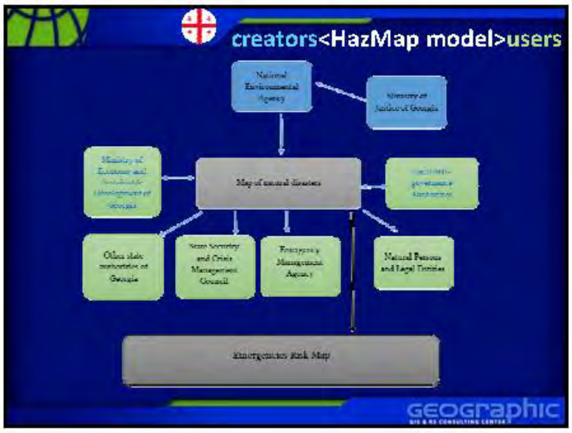
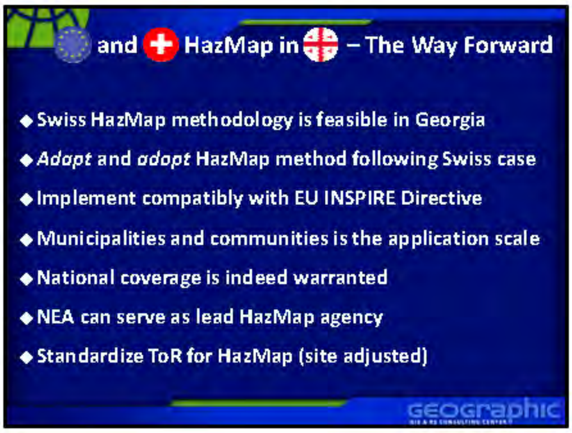
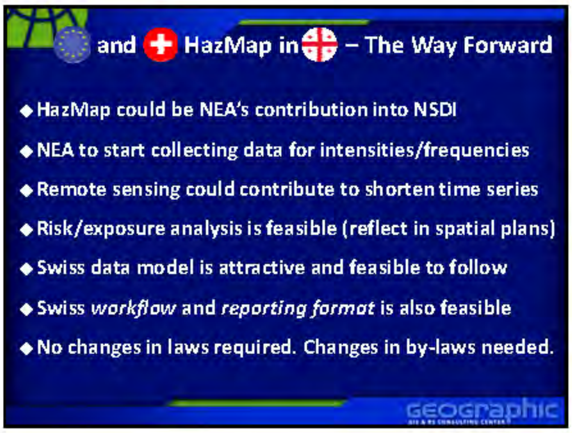
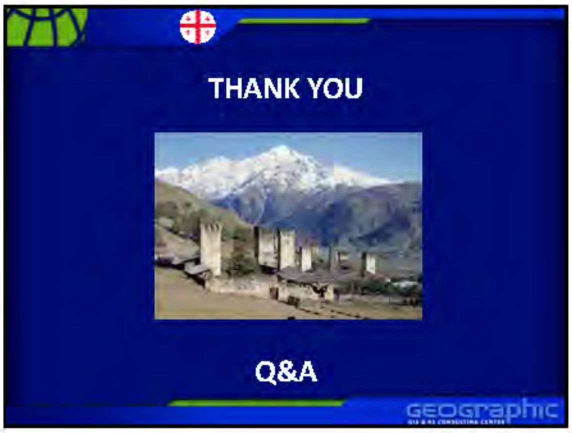

creators<HazMap model>users
National Environmental Agency
Ministry of Justice of Georgia
Map of natural disasters
Other state authorities of Georgia
State Security and Crisis Management Council
Emergency Management Agency
Natural Persons and Legal Entities
Emergencies Risk Map
GEOGRAPHIC


and HazMap in – The Way Forward
Swiss HazMap methodology is feasible in Georgia
Adopt and adopt HazMap method following Swiss case
Implement compatibly with EU INSPIRE Directive
Municipalities and communities is the application scale
National coverage is indeed warranted
NEA can serve as lead HazMap agency
Standardize ToR for HazMap (site adjusted)
GEOGRAPHIC


and HazMap in – The Way Forward
HazMap could be NEA's contribution into NSDI
NEA to start collecting data for intensities/frequencies
Remote sensing could contribute to shorten time series
Risk/exposure analysis is feasible (reflect in spatial plans)
Swiss data model is attractive and feasible to follow
Swiss workflow and reporting format is also feasible
No changes in laws required. Changes in by-laws needed.
GEOGRAPHIC


Why HazMap?
To avoid:
Jamushi, Mulakhi Valley, 1987
Tbilisi, Vere Valley, 2015
GEOGRAPHIC


THANK YOU
Q&A
GEOGRAPHIC