Institut de Physique du Globe de Strasbourg, École et Observatoire des Sciences de la Terre

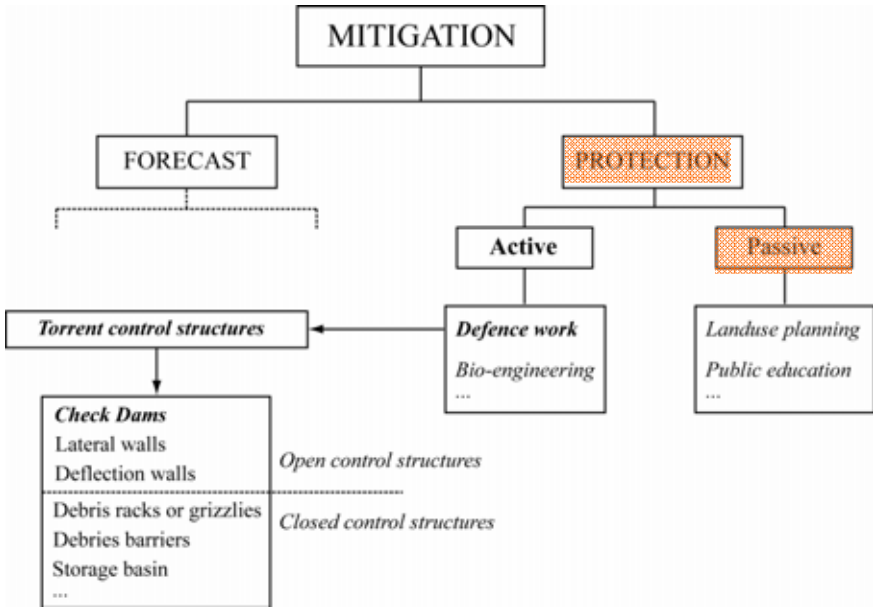
The French methodology for natural risk mapping - PPRn

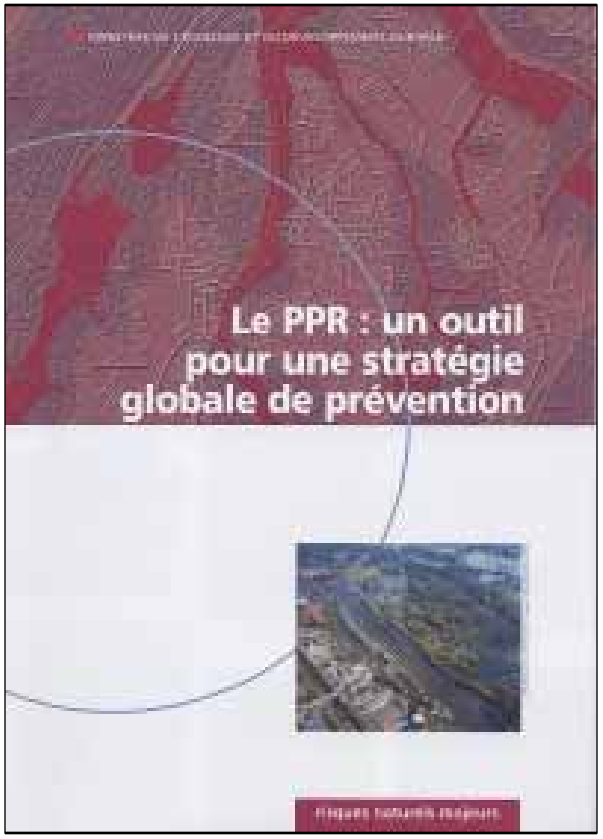
(Plan de Prévision des Risques Naturels)

J.-P. MALET
A. REMAITRE

CNRS UMR 7516, School and Observatory of Earth Sciences, Strasbourg, France

Natural risk mitigation in France





Argile Avalanche
Cartographie Catastrophe
naturelle **Concertation**
Construction Cyclone
enjeu **Expropriation** Feux de
forêt **guide** **information** PPRT
Retour d'expérience retrait-
gonflement Risque industriel risque
industriel Risque nucléraire Risque
technologique **risques**

Institut de Physique du Globe de Strasbourg, École et Observatoire des Sciences de la Terre

The PPR methodology: Background and current status on landuse and risk mapping: from PSS (1935) to PPR (1995)

What has been carried out in France since 1935?

1. Land-use mapping

At the local scale, the "**P**lan d' **O**ccupation des **S**ols" (P.O.S) [today the "**P**lan **L**ocal d'**U**rbanisme" (P.L.U.) 'Local Planning Plan' since 2001] is the basic **statutory** document, including a map - **at the community scale** (usually 1:5,000) and a presentation report.

This land-use map divides the territory in urban zones and natural zones

At **the regional scale** (1:50.000 to 1:250.000), **landuse master maps** are embedded to large development projects. But the community level is the most important for risk mapping.

2. How are natural risks taken into account in the land use planning

What are the documents/methods used in France?

+ PSS (1935): ("submersible surface maps", PSS in French) indicates the possible flooded areas in which any construction is under control, to keep free the running water. This procedure concerns several communities along the rivers and aims to reduce urbanization in these areas.

+ Article R.111-3 of the urban code: **mapping of risks areas, at local level,** has been extended to landslides and avalanches, with floods in order to control and, sometimes, to prohibit any construction or urbanization in the risk prone areas. The risk zones are independent of the municipal boundaries.

The documents drawn up under this procedure are applicable to 3rd parties, but do not affect exiting constructions. Only the **future** urban development are concerned by this regulation.

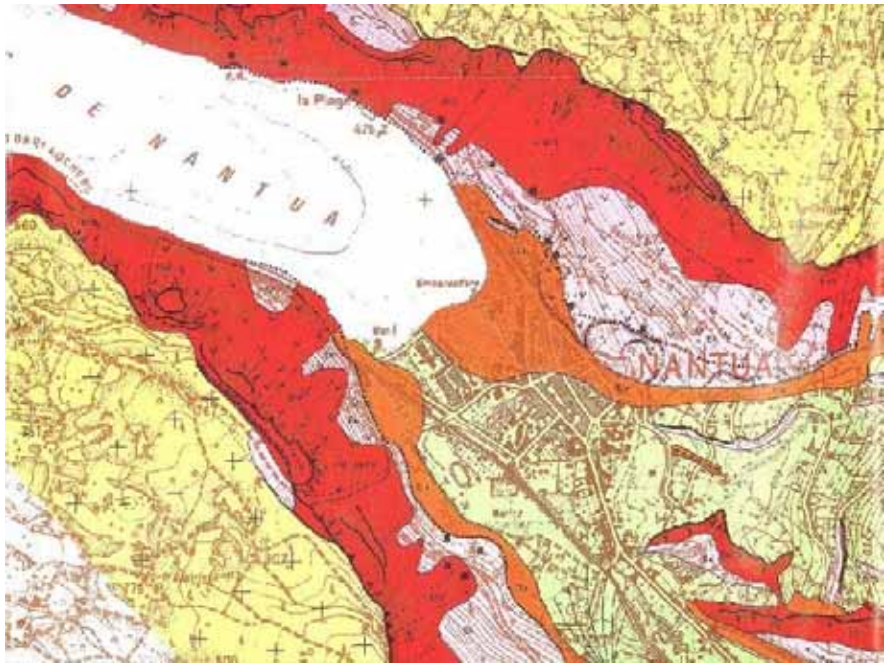
+ ZERMOS (1970s): first risk mapping document for slope instability.

ZERMOS is the French acronym for '*Zones Exposed to Risk of Movements of the Surface and Subsurface'.*

Institut de Physique du Globe de Strasbourg, École et Observatoire des Sciences de la Terre

At the scale 1:25.000, ZERMOS are informative maps which define potentially unstable areas.

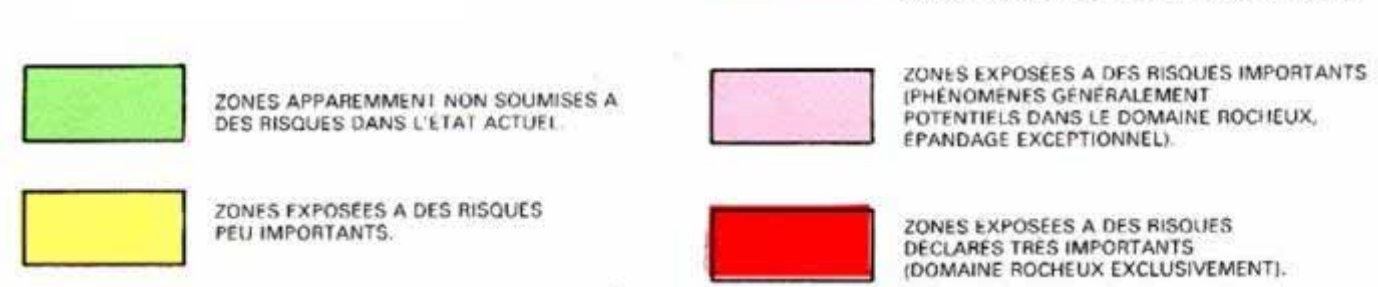
The data concern only the natural phenomena: no stakes are taken into consideration.



Zoning in 5 classes:

- No potential instability (green)
- Low potential instability (yellow)
- Moderate potential instability (brown)
- High potential instability (orange)
- Very high potential instability (red)

Example of the Zermos map of Nantua



PER (1982): The **law** of 13th July 1982 set up the "**Risks Exposure Plan**" **(PER, in French).** This law introduces prevention measures, which have to be carried out by owners as well as by communities or public bodies, not only for **future construction**, but also **for existing construction**.

At the same time, the law creates a link between prevention and compensation.

The non respect of the preventive measures can modulate the level of compensation.

PER maps are drawn at scales of 1:5000 to 1:10.000, in order to be compatible with urban-planning documents, and are legally binded at the municipality scale.

PER comprises several documents: (1) the information map of natural event, (2) the hazard map, (3) the vulnerability map, (4) the PER delineation plan, and (5) a report describing the regulation.

The procedure is very slow and 'complex': Assessment of vulnerability with 'complex method' (scale of the document (1.5000) with a lot od details required, the obligation to study the whole territory of the commune (also in the 'zone' without risk!), rigidity of the procedure, high cost to prepare the documents, ……

➔ **For these reasons, the State has modified the law in 1995**

Institut de Physique du Globe de Strasbourg, École et Observatoire des Sciences de la Terre

PPR (1995): a new law that regroups all the risk mapping "tools", and sets up the "**Risk Prevention Map" (PPR)**. PPR is a basic risk map at the local scale, to be shifted into the statutory land-use map (POS).

These documents have to be prepared at the 1/25.000 scale (generally topographic map enlarged at the 1:10.000).
PPR is an unified and standardised document of prevention.
With pragmatism, PPR link together (1) existing knowledge and (2) qualitative studies

The area covered by the documents corresponds to either municipality or to a "risk catchment" limited by natural boundaries and that may cover several municipalities.

PPR are elaborated for the most exposed municipalities. The priority municipalities are chosen according to the number of observed events [*Dossier Départemental des Risques Majeurs -DDRM*] and on information provided by inter-ministerial decrees establishing the state of natural disaster.

The hierarchy of communes is defined assuming the risk basin concept and the technical/budget resources that can be mobilised by the State ('Barnier funding' until 2010).

Documents are mono-risk but sometimes they can be multi-risks and associate landslides, floods, snow avalanches and earthquakes.

The zoning is established for a reference period of 100 years

PPR is composed of 3 documents (PPR Guide, 1999, Leroi, 2005):

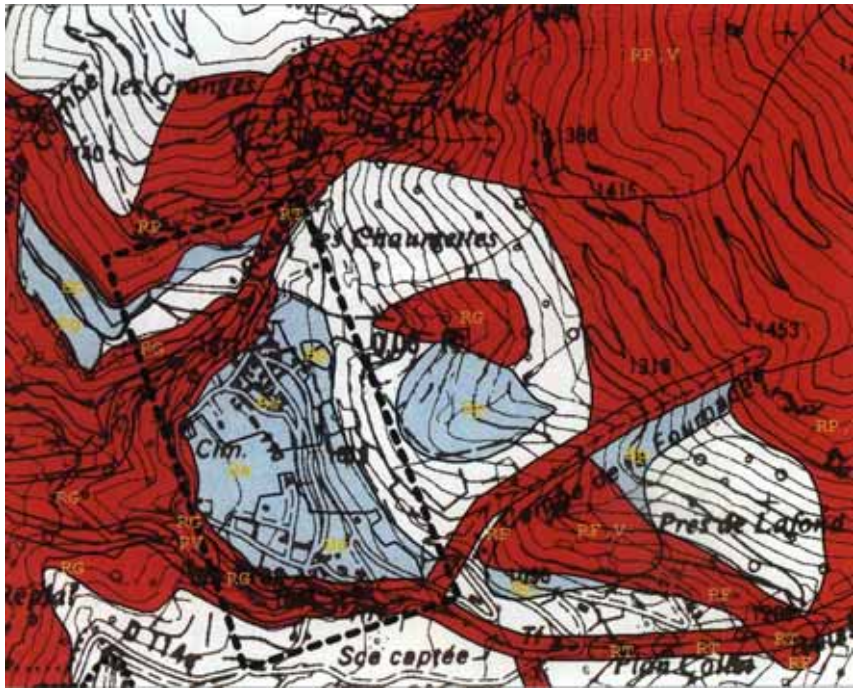
- A **presentation note**
- A **statutory zoning plan** with 3 zones:
- A **three-level regulation reports**:

A/ The presentation note aggregates:

- The reasons for the PPR prescription
- The map of the known natural phenomena
- The hazards, taking into account the uncertainties
- The major stakes and exposed elements
- The objectives aimed at for risk prevention
- The choice of zoning and the statutory measures

B/ The statutory zoning plan distinguishes 3 zones:

- the **red zone** (high exposed zones, with high risk occurrence and high intensity of hazards) where building is not allowed
- the **blue zone**, where the risk occurrence and the hazard intensity allow urbanization and building, but with specific conditions to be respected
- **the white zone** (unexposed zones with negligible risk) where building are allowed



R1: Area without specific restriction.

R2: Area with low restriction.

R3: Area with specific restrictions.

C/ A 3-level regulation report which defines:
- The limits on the new constructions:
- The general prevention and protection measures
- The measures applicable to the existing constructions

* Limits on the new constructions:

The basis of the PPR is to stop the development of urbanisation in the zones where the risk is the highest

In the areas where new constructions are allowed and in agreement with the local planning plan (PLU), these constructions are subject to compulsory provisions.

Planning, building & management regulation must be clearly stated, realistic and proportional to the stakes.

*** General prevention and protection measures:**

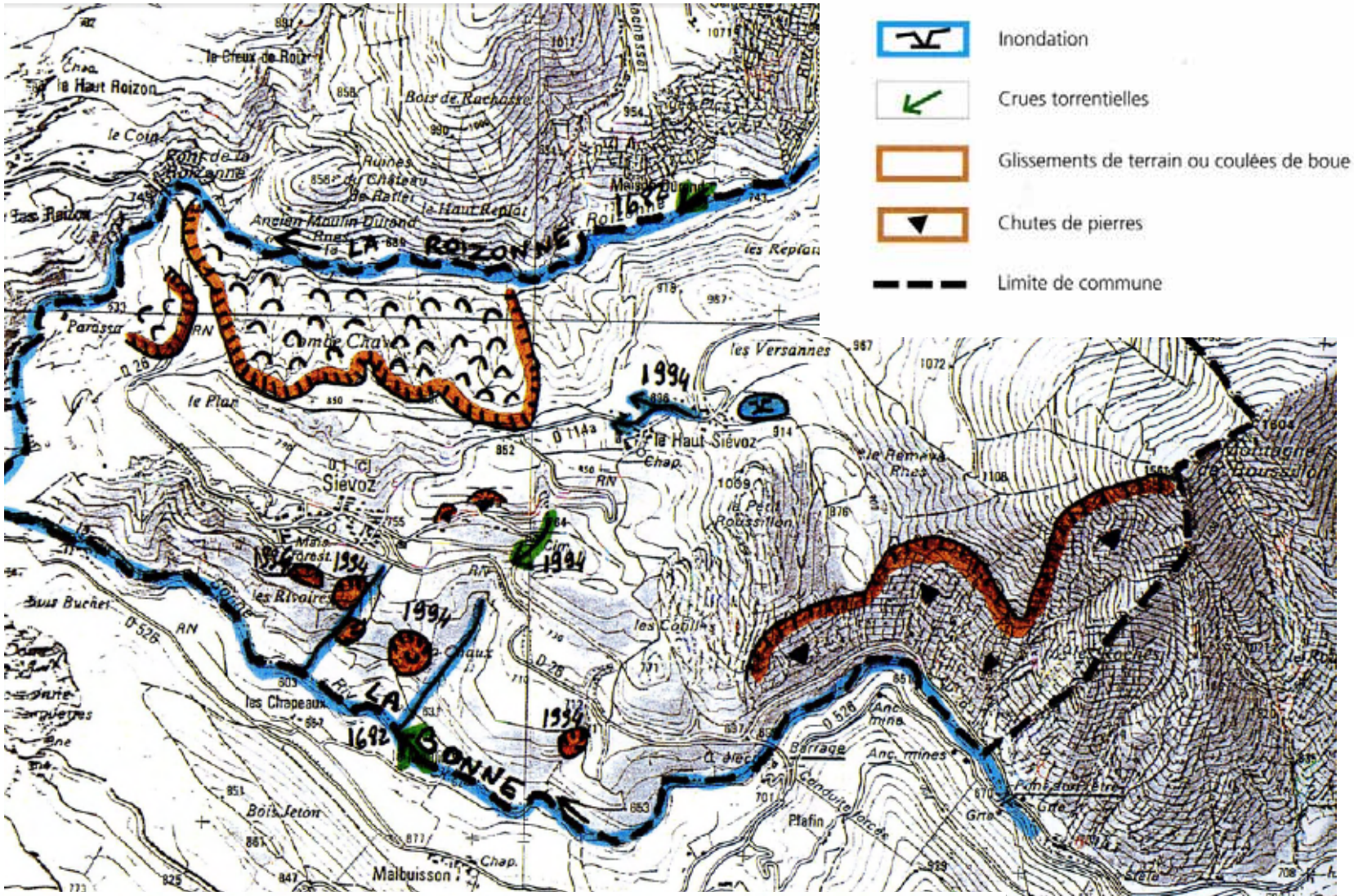
They include the measures to be taken by the private owners, and the collective measures of the public project managers.

*** Measures applicable to existing constructions:**

They concern the planning, use or operation related to the existing buildings and to any type of planning that may have an influence on the risk.

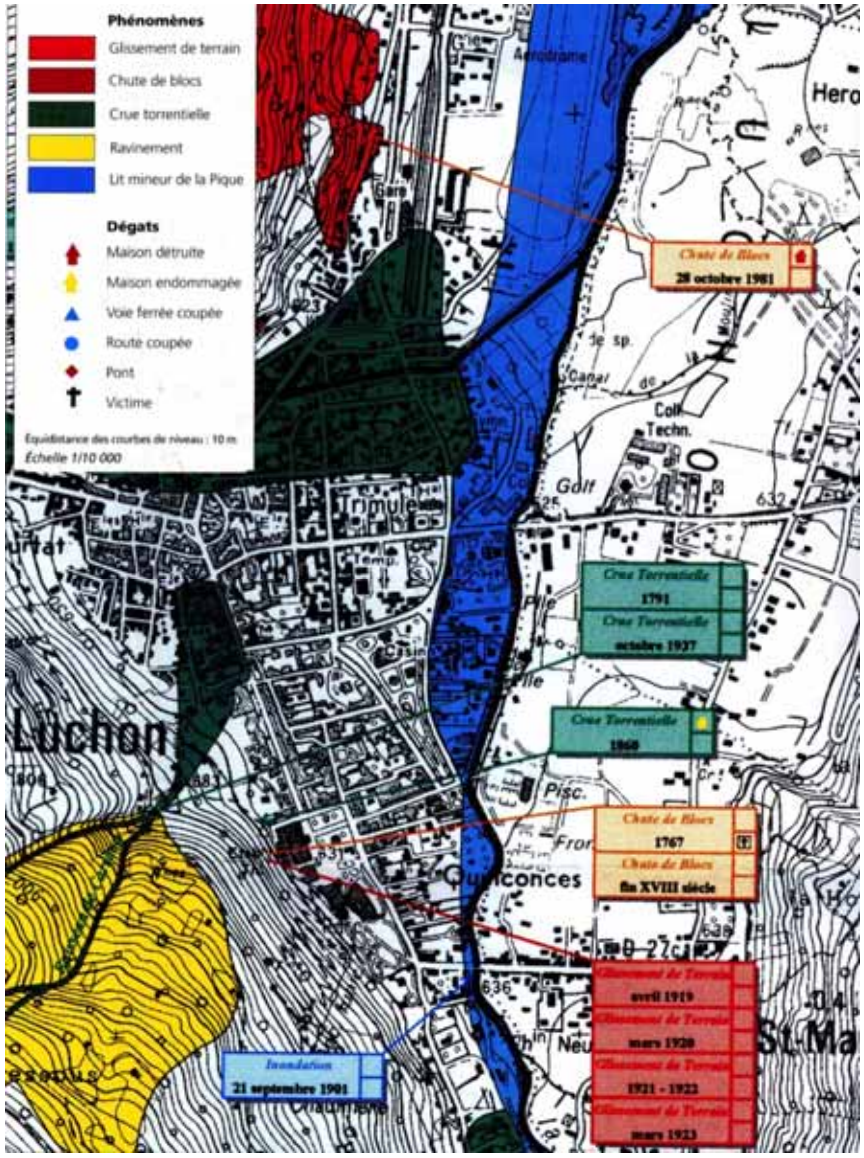
Prevention and protection measures, as well as the measures applicable to the existing constructions can become compulsory within a maximum deadline of 5 years with automatic enforcement by the state if they have not been performed in time.

* Example of maps



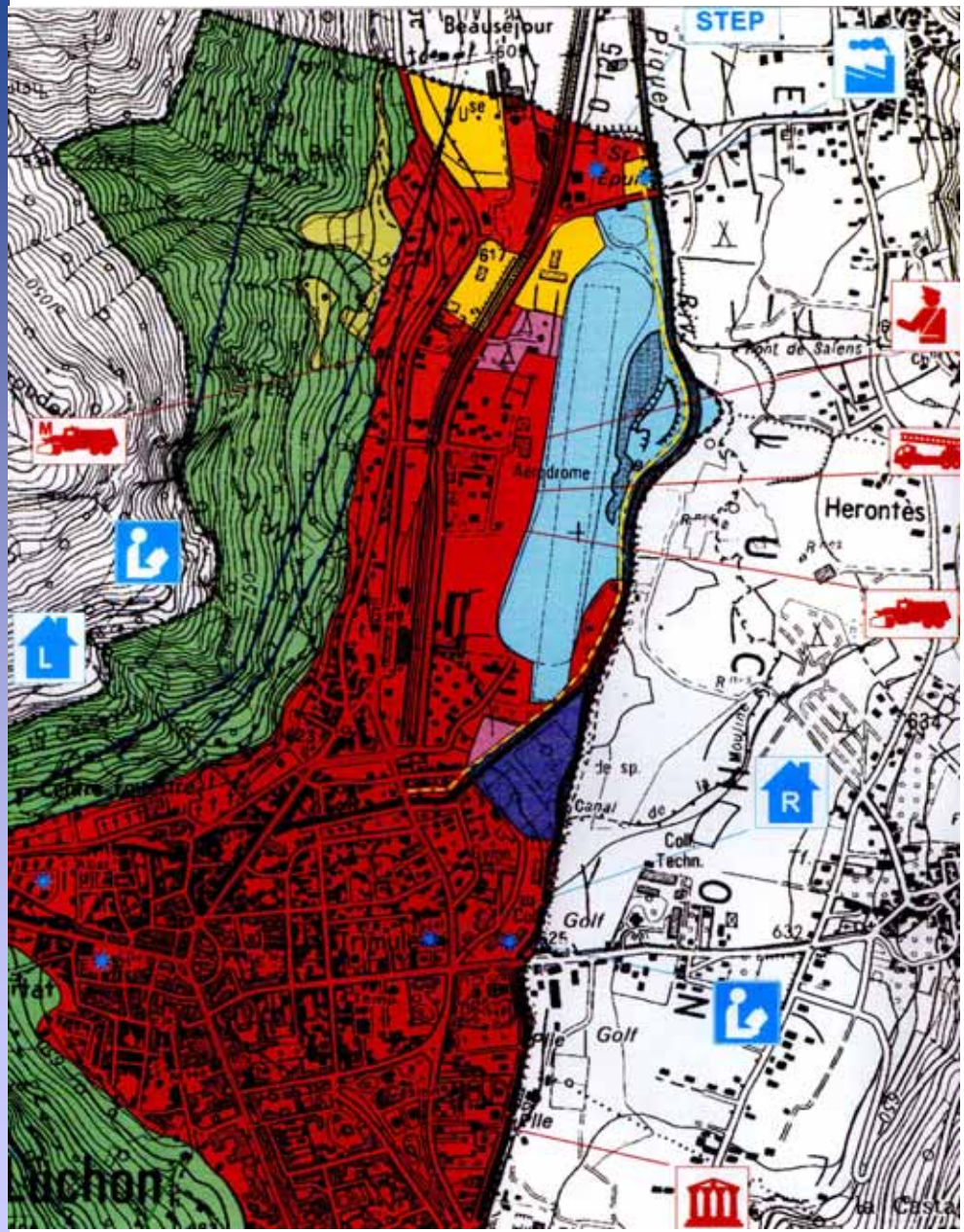
de localisation des phénomènes : Sievoz (38)

* Example of maps



Carte de localisation des phénomènes naturels : Bagnères-de-Luchon (31)

Institut de Physique du Globe de Strasbourg, École et Observatoire des Sciences de la Terre

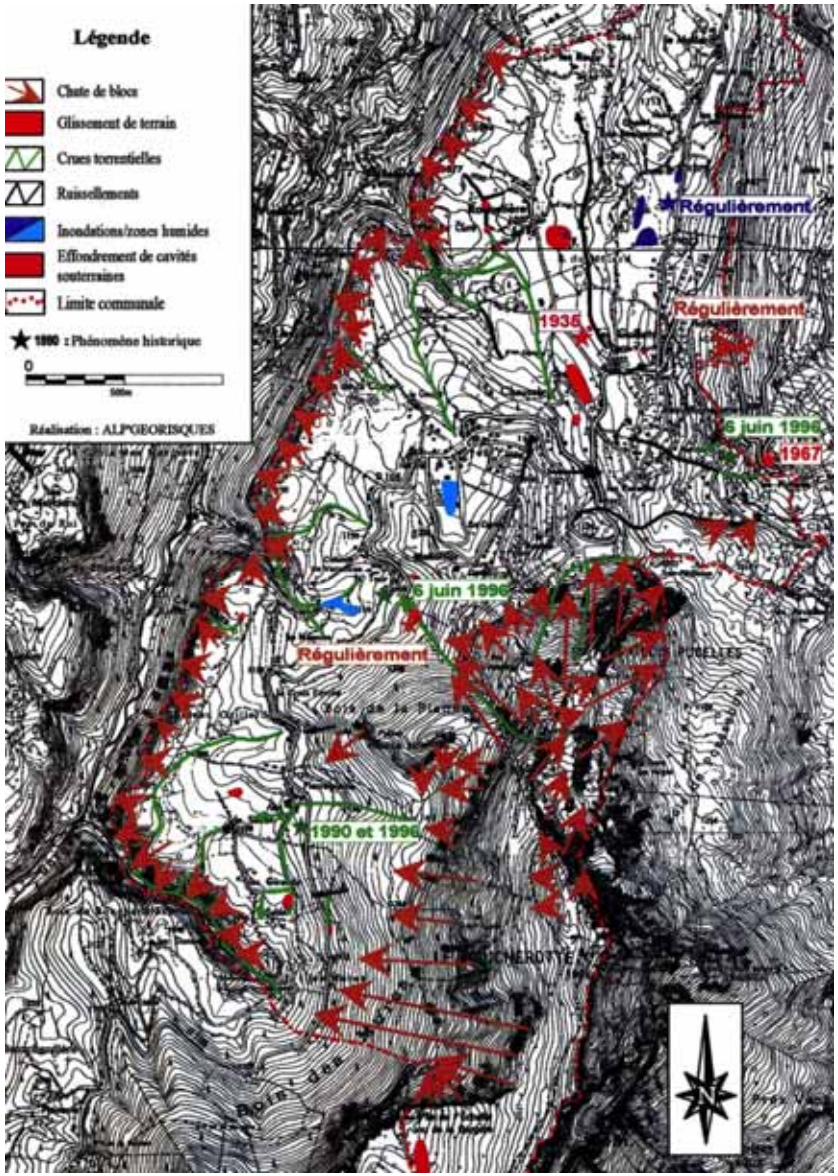


Carte des enjeux : Bagnères-de-Luchon (31)

Échelle 1/10 000

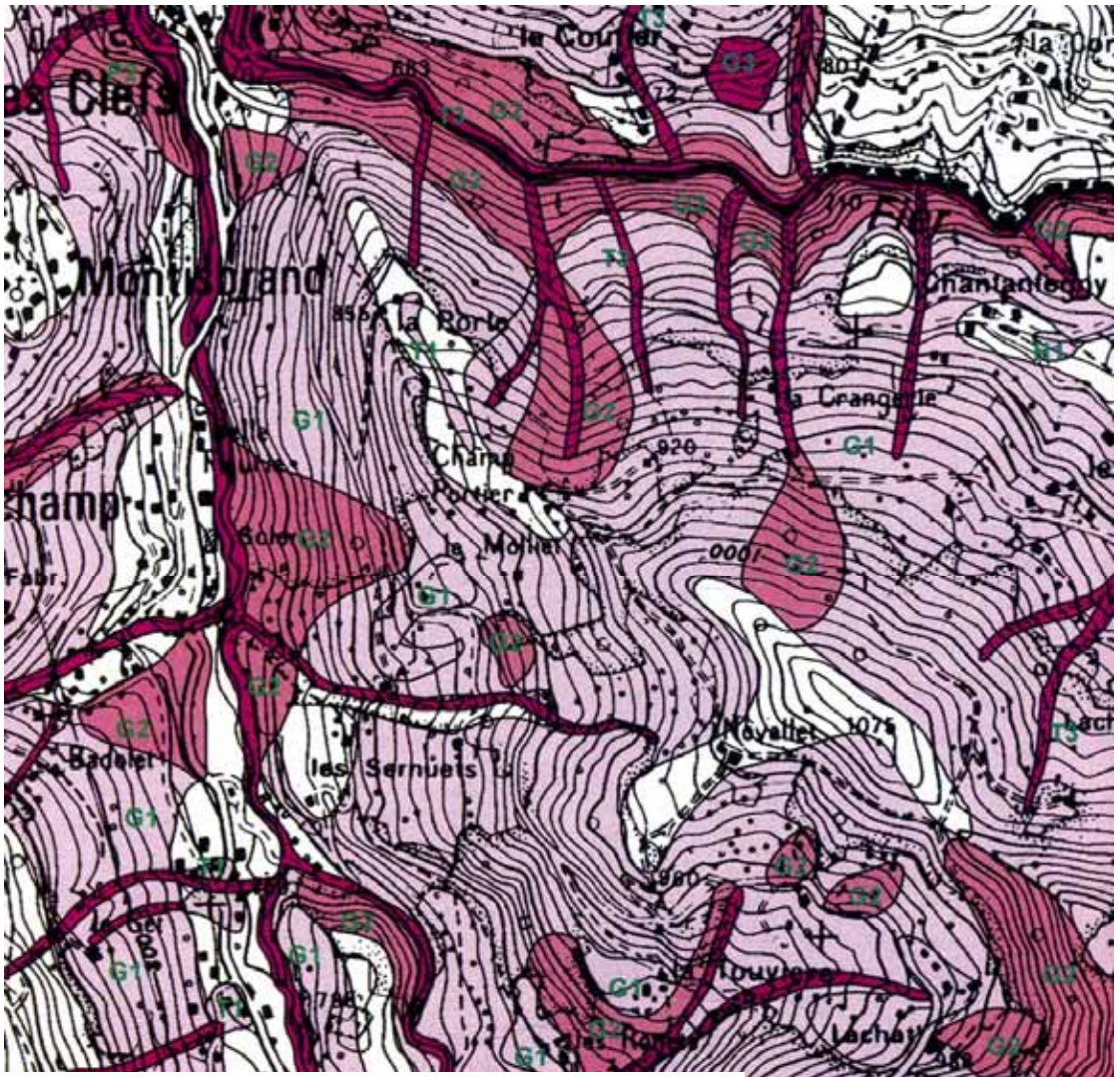
- Centre ville ou village
- Zones urbanisées
- Zones industrielles ou commerciales
- Camping
- Routes principales
- Routes importantes (accès unique)
- Routes secondaires
- Voies ferrées
- Zones agricoles
- Zones de loisirs
- Infrastructures sportives
- Zones naturelles
- Lignes électriques haute tension
- Aqueducs
- Conduites forcées
- Gazoducs
- Mairie
- Centre de secours
- Services techniques
- Subdivision ou garage DDE
- Gendarmerie
- École ou collège
- Centre de vacances
- Maison de retraite
- HLM
- Centre équestre
- Réservoir d'eau potable
- STEP Station d'épuration
- Station d'épuration de camping
- Usine de traitement des ordures ménagères
- Poste de transformation

* Example of maps



Carte informative des phénomènes naturels : Sassenage (38)

* Example of maps



Carte des aléas : Les Clefs (74)

Aléa fort

Aléa moyen

Aléa faible

Aléa considéré comme nul

Source : RTM 74 (1996)

A3

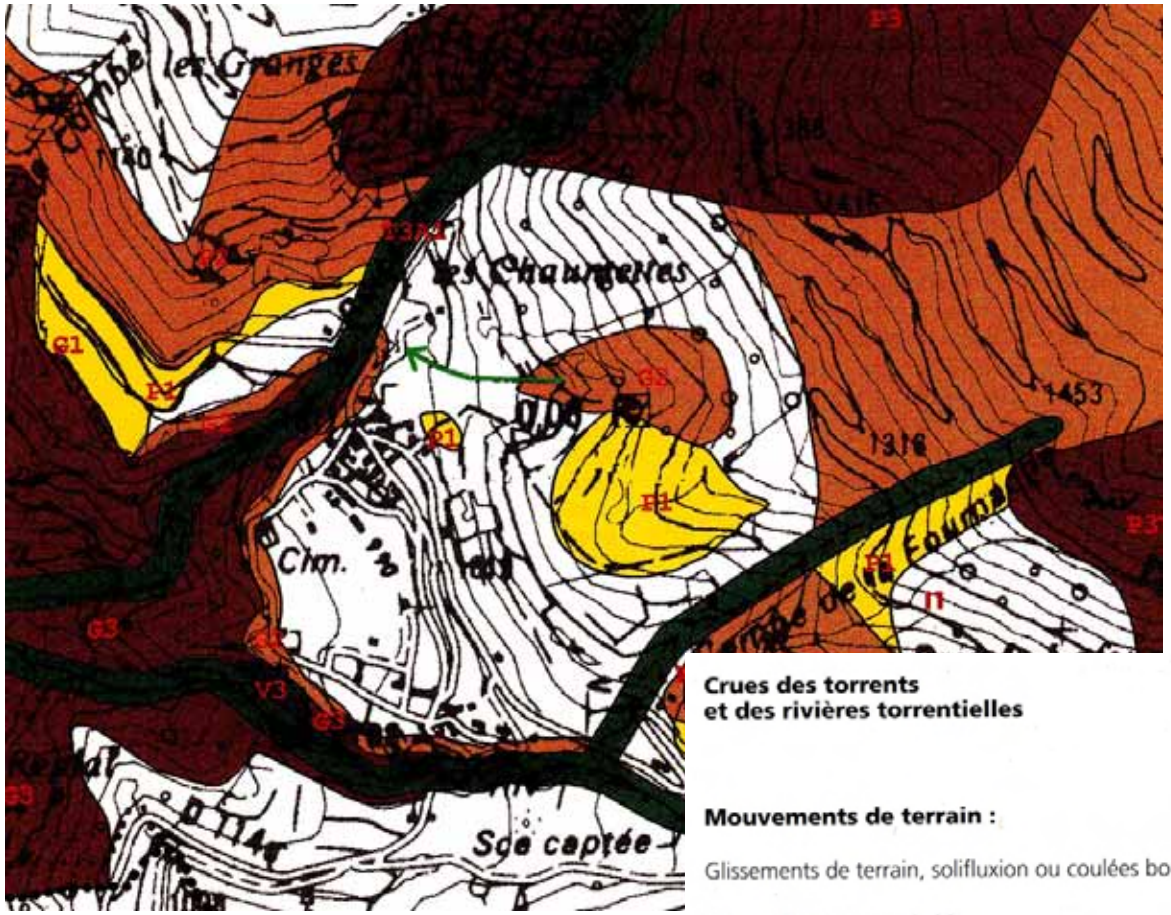
Type d'aléa :
A : avalanche
G : glissement de terrain
H : zone humide
P : chute de pierrres
T : crue torrentielle

Degré aléa :
1 : faible
2 : moyen
3 : fort

Équidistance des coubes de niveau : 10 m

Échelle 1/10 000

* Example of maps

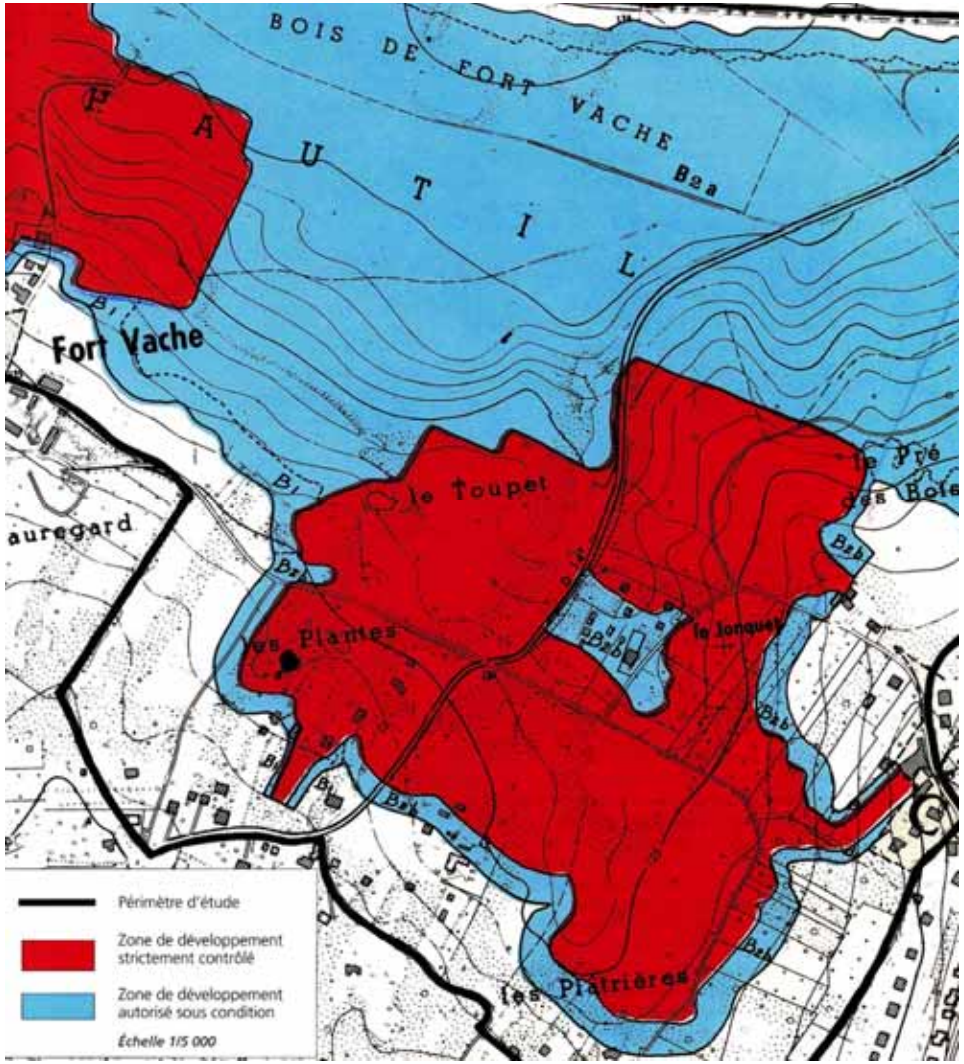


Carte d'aléas
Oris-en-Rattier (38)

Crues des torrents et des rivières torrentielles	Faible	Moyen	Fort
	I1	I2	I3
Mouvements de terrain :			
Glissements de terrain, solifluxion ou coulées boueuses	G1	G2	G3
Chutes de pierres et de blocs	P1	P2	P3
Effondrement de cavités souterraines		F2	
Divagations torrentielles et axes de ruissellement			
Limite communale			

* Example of maps

Plan de zonage réglementaire : massif de l'Hautil, Vaux-sur-Seine (78)

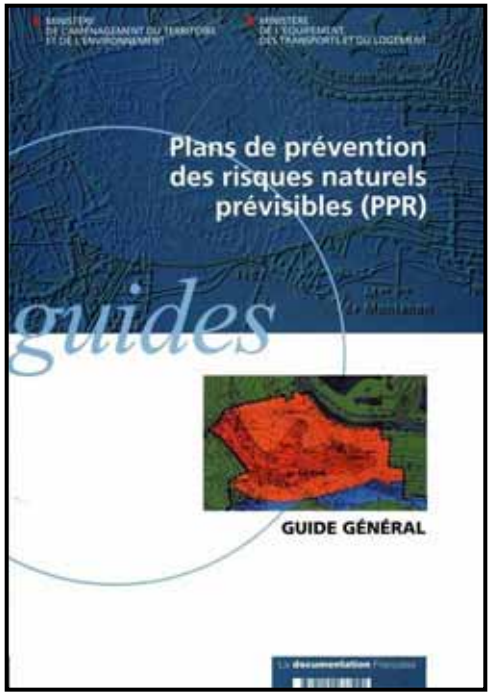


Institut de Physique du Globe de Strasbourg, École et Observatoire des Sciences de la Terre

To prepare a PPR, several **methodological guides** have been elaborated under the responsibility of the State.

The first one is a **General Guide**, presenting the methodology.

The other guides are **Specific Guides related to each hazard**, and concern flooding, landslide, coastal erosion, earthquake, etc…



➔ The General Guide defines the procedure, the strategy and the PPR impacts.

➔ The Specific Guides present the prevention policy, the hazard description, and the specific criteria to take into account to for the evaluation/mapping

Statutory legal procedure:

Order of prescription

(by Prefect with agreement of the Mayor)

(Starting point for the elaboration of the document)

↓

Consultation of the Municipality Council

↓

Public Enquiry

↓

Approbation of the PPR

↓

Annex to the PLU