Water Sector Performance and Investment Programme

WPIP MIP V
Institutional Consultant

Municipal Infrastructure Programme V

Local Emergency Plan Lezha.

April 2024

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Purpose of this manual

This local emergency plan presents the planning concepts of flood management planning and contains guidelines for prefectures and municipalities regarding the preparation of emergency respond schemes for flooding. This first version of the emergency respond scheme for Lezha can rather be used as a guideline for organizing disaster management planning. Better, it should be used as a template to gradually upgrade this version taking advantage of any experiences and lessons learned of coming emergency actions.

This local emergency plan for Lezha has been developed based on several sources, including the Albanian legal framework, EU directives, and guidelines from the EU project PRONEWS. Additionally, it incorporates inputs from the Lezha Flood Risk Management Plan, which has been updated with risk assessments from the detailed design report for Lezha, along with other relevant documents from the MPIP/MIPV project. This document was drawn up with the support of meetings interchanged with:

- Mr Zef Maçi, Director of UKR Lezha,
- Mr Gjergj Prendi, Prefect Qark Lezha
- Mr Nikoll Tushi Chief of emergency department Prefecture Lezha
- Mr Brikena Ndoci: Specialist at Civil Emergency Department at Lezha Municipality
- Mr Paulin Gjergji : Specialist at Civil Emergency Department at Lezha Municipality
- Mr Bonati; Head of Performance Management Directorate of Water Resources Management Agency Tirana

Audience (interested persons)

It is mainly addressed to officials of UK Lezha, Prefecture of Lezha, General Directorate of Civil Emergencies of the municipality of Lezha and the irrigation board of Lezha, who are responsible for preparing plans for Disaster Risk Management (DRM).

1 INTRODUCTION

Resilience is the guiding concept for policymaking related to multi sectorial development and especially in terms of disaster risk management. It is the ability of a country, authority and socio-ecological systems to recover in a comprehensive and multidimensional way from a crisis.

This implies that if public infrastructure service providers improve their capacity in governance and in the sustainable management of natural resources, then the resilience to climate change and natural hazards will be enhanced and public institutions will be more effective with the consequence that people and businesses will benefit from improved services.

Investments in DRM yield economic, social and environmental benefits; in a middle income country as Albania, UNISDR is calculating that investing US $1 in more resilient socio economic infrastructure returns US $4 in benefit.

The UN Sendai Framework for Disaster Risk Reduction 2015-2030 outlines four priorities for action to prevent new and reduce existing disaster risks:

(i) Understanding disaster risk;
(ii) Strengthening disaster risk governance to manage disaster risk;
(iii) Investing in disaster reduction for resilience and
(iv) Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation, and reconstruction.

Key element in the preparation of DRM strategies and policies is the **disaster management cycle**. In line with the four priorities for of the UN Sendai framework, **four stages of emergency response planning** can be underlined at local level of governance.

- Planning & Mitigation
- Preparedness
- Response
- Recovery

Definitions for each stage of emergency management:

- **Planning & Mitigation**: Evaluation of the potential types of disasters and the development of plans for reducing their probability or their impact on life & resources.
- **Preparedness**: Actions undertaken when mitigation efforts have not prevented or are unable to prevent a disaster from taking place.
- **Response**: Activities that occur in the wake of a disaster that are intended to identify and assist victims and stabilize the overall disaster situation.
- **Recovery**: Actions following a disaster that aim to restore human and environmental systems back to normal. At the end of this phase, a *post-flood resilience assessment* must be organized to ensure regular updates to the emergency plan.

The disaster management cycle is important for the specific case of Lezha Municipality where the community has a high vulnerability, and the municipality has a low capacity in all four links of the cycle. Then interventions to improve the situation must be developed in all stages of the cycle.

The City of Lezha is subject to frequent flooding that adversely impacts the lives and livelihoods of the city's residents and businesses. As part of the "*Water Sector Performance and Investment Programme (WPIP) / Municipal Infrastructure Programme V (MIP V)", a* special focus has been placed on finding sustainable solutions to the ongoing flood issues in Lezha.

This emergency respond scheme explains in line with UN Sendai Framework and the EU Flood Directive (EUFD) how flood risk can be managed by the local policymakers with the intent to mitigate the impact of flooding for the citizens of Lezha and to help the communities of Lezha in becoming more resilient regarding climate change, flooding, and other natural hazards.

1.1 Objectives for flood risk management in Lezha city

General objective: The municipality of Lezha is a municipality with a sustainable development and capable of coping with water related natural disasters.

Specific objectives derived from various discussions with stakeholders to manage the flood risk in Lezha are summarized in Table 2. A reduction in the frequency and severity of flooding in Lezha feeds into many of the stated objectives. A second major consideration is the reduction of maintenance requirements to ensure the sustainability of any proposed measures.

In accordance with the general vision of the DRM strategy, with the principles of the Sendai framework, and with the disaster management cycle, the following strategic objectives (SO) are drawn up.

- **SO1** Information, awareness and community capacity building for DRM
- **SO2** Raising the institutional and financial capacities of Lezha Municipality for DRM
- **SO3** Disaster Risk Mitigation through interventions and measures in the territory
- **SO4** Institutional and operational capacity building and preparation for dealing with situations emergency.

As mentioned above, strategic objectives are directly related to the disaster management cycle. The following table shows the relationship of the objectives to the different phases of the disaster management cycle:

Table 1: The connection of strategic objectives with the phases of the disaster management cycle.

	SO1	SO2	SO3	SO4
Planning & mitigation				
Preparedness				
Response				
Recovery				

Table 2: Summary of specific Objectives for Flood Risk Management in Lezha

	Mitigation of Social impact
SO3	Reduce the proportion of the population affected by frequent flooding
SO3	Reduce disruption from flooding to businesses, key services and infrastructure
SO1	Improve awareness of the community to flood risk

SO4	Ensure effectiveness of emergency response plans for flooding
	Mitigation of Economic impact
SO3	Reduce the recurrent cost of flood damage to properties and buildings
SO2	Reduce the cost of damage to public infrastructure
SO2	Reduce the cost of operating the existing combined sewer system and waste water treatment plant
SO2	Substantially reduce the cost of cleaning and maintaining the stormwater channels
	Mitigation of environmental impact
SO2	Promote sustainable urban development practices
SO3	Protect and enhance the natural landscapes and protection areas of the catchment and adjoining areas. Tree planting on hill slopes to reduce runoff and sediment wash-off
SO3	Conserve and enhance cultural heritage assets and reduce exposure to flood impacts
	Preparedness
SO2	Elaboration of Risk Identification and Risk scenarios
SO2	Identification of the coordination chain at different territorial levels;
SO1	Description of the early warning system at different institutional levels,
SO1	Definition of communication procedures and methods, regarding the territorial coordination system;
SO1	Creation of specific communication and information activities, in ordinary and emergency situations, aimed at the public with regard to exposure to risks, the emergency plan and self-protection behavior.
SO2	Training & Exercising
	Response
SO1	Activation of alarm communication and Establish Command & Control Centre
SO1	Creation of specific communication and information activities, in ordinary and emergency situations, aimed at the public with regard to exposure to risks, the emergency plan and self-protection behavior.
SO3	Implementation of measures to protect and secure public and private buildings and cultural heritage, and to ensure the functionality of transport networks, essential services and communications.
SO3	Relief and assistance to the population (search and rescue, first health care, removal from areas at risk, temporary housing, psychological and social support, assistance to the most vulnerable population groups, etc.)
SO3	Deploying Flood Barriers / Flood Protection
	Recovery
SO2	Control and maintenance of the waste and storm water infrastructure
SO2	Evaluation of safeguard measures and prompt reactivation of the productive economic system, of the personal services supply chain, in the continuity of administrative action;
OS2	Post-flood resilience assessment and formulation of lessons learned for a regularly Update of the emergency scheme
OS2	Enhancing disaster preparedness for effective response, and to «Build Back Better» in recovery, rehabilitation and reconstruction

1.2 Updating/ Reviewing

This section will explain the procedures of updating and reviewing the plan. Plans need to be refreshed from time to time, as organizations and resources may change. Having a current and appropriate plan

is a difficult task, but can be achieved by reviewing, completing, and updating it regularly to ensure its currency.
The following section lists items that should be included:

- Update procedures of the plan:
  - The plan should be updated on a regular basis
  - The plan should be updated every time that a major change happens in the prefecture, both politically and territorially:
    - at the approval of a new law
    - after or before the approval of the urban master plan
    - if risk changes drastically in the territory of the prefecture
  - The plan should be updated if something changes at technical or scientific level
    - A new reliable and codified meteorological/seismic/forest fire bulletin is released
    - New procedures for monitoring natural hazards are implemented (new weather stations, new radar, new data…)
    - New procedures for the communication of risk are issued

INDICATE THE TIMING OF THE UPDATES AND THE RESPONSIBLE PERSON/OFFICE IN THE PREFECTURE IN CHARGE:

TIMING OF UPDATES: _____
RESPONSIBLE PERSON/OFFICE:_____

Furthermore, the plan should, if possible, be reviewed by a qualified authority tasked with this duty at National or prefectural level.

- Review procedures:
  - The plan is revised every time major changes are introduced.
  - The person/institution in charge ensures the correspondence with national and prefectural legal and institutional framework.
  - The persons/institution in charge communicates with GDCE the relevant changes allowing the national level to have always an overview over the current situation of the plans.

INDICATE RESPONSIBLE PERSON/OFFICE/INSTITUTION IN CHARGE OF THE REVIEWS:

_____

1.3 Competent Authorities

Flood risk management in Albania generally comes under the purview of multiple organizations, including central government ministries and agencies. However, given the restricted geographical context of the Lezha flooding issues, the main institutions involved are local in nature. The core stakeholders in Lezha therefore comprise the following institutions:

Institution	Responsibilities
UK Lezha (Water Utility)	Is Lead partner and the responsible authority for managing and maintaining the existing and the combined sewer drainage system, see indication on **Figure 1.** Operating Procedures (for instance O&M protocols): • the sewerage infrastructure – colour red • the combined sewer (existing); – colour black • the combined sewer (new); – colour pink • pumping station wastewater • wastewater pumping installations. Stakeholder Engagement Public Awareness
Drain Board (department managed by central government – NCEP)	Is the responsible authority for managing and maintaining:? • the stormwater infrastructure; main collectors or bigger pipes • pumping station stormwater • overflows and gravel and sand traps
The Prefect of Qark	• Supervise and manage, on a regional level, all the representation of central structures, which have been incorporated in the region's (Qark's) civil emergency plan. • Establishes the Qark Commission for Civil Emergency Planning and Response* • Respond to civil emergency situations that exceed the capacities and means in the region, by requesting the proclamation of a State of Civil Emergency for part or all of the region's territory. • Respond to a civil emergency situation on a national level, by keeping constant contact with local and national governments institutions • In situations of civil emergency, the material and human resources provided for in the Qark Civil Emergency Plan, are placed under the authority of the Qark Head of

	Operations. He/she accordingly becomes responsible for the management of the civil emergency situation.
Department of Civil Emergencies in Lezha Municipality	• Leads and organizes the drafting's work for operational plans on civil emergencies in all Administrative Units of Lezha Municipality. • Operating Procedures (for instance O&M protocols): the small stormwater infrastructure (small pipes along the street) • Reports to the Prefect and the Regional Civil Emergency Planning and responds Commission on the civil emergency situation and addresses any necessary requests to ensure the provision of relief assistance. • Organizes and informs the population. • Provides (foresees) sources and reserves necessary for population in natural disaster events. • Cooperates and coordinates the work with Directorate of Fire Protection and Rescue and other Regional and National Institutions in civil emergency events. • Follows up on rehabilitation (restores) of facilities after natural disaster events or other disasters.
Drainage Board – Ministry of Agriculture	Is the responsible authority for managing and maintaining:? • mainly agricultural drains • pump systems surrounding Lezha • maintaining the Drini River channel in Lezha and river flood protection infrastructure. • Working groups for preliminary and specialized damage assessment and needs
Albanian Red Cross (ARC)	In case of a civil emergency, ARC establishes: • information centers, • carries out damages and needs assessment, • provides first aid and psychosocial assistance/service, undertakes relief distribution and ensures normal living conditions for the affected population • is involved in the tracing of mission persons and family reunion in cooperation with the International Committee of the Red Cross (ICRC). • organizes education activities with the community, • providing information and counseling for different types of emergencies, especially public health and environmental issues.

*****The Qark Commission for Civil Emergency Planning and Response will:

- Coordinate institutional actions necessary in all stages of civil emergency response.
- Coordinate actions on a regional level with the actions and activities of central structures of the local government, the Albanian Red Cross, volunteers, and different donors.
- Discuss and make preliminary decisions on the material and financial needs required to prevent and mitigate civil emergency situations, estimate potential damage caused due to a natural or man-made disaster, estimate reconstruction and rehabilitation costs of a disaster-affected region, and request the support of other central structures on a regional level.
- Coordinate the actions of the municipal and communal committees, and the relief teams and volunteers operating in the region.

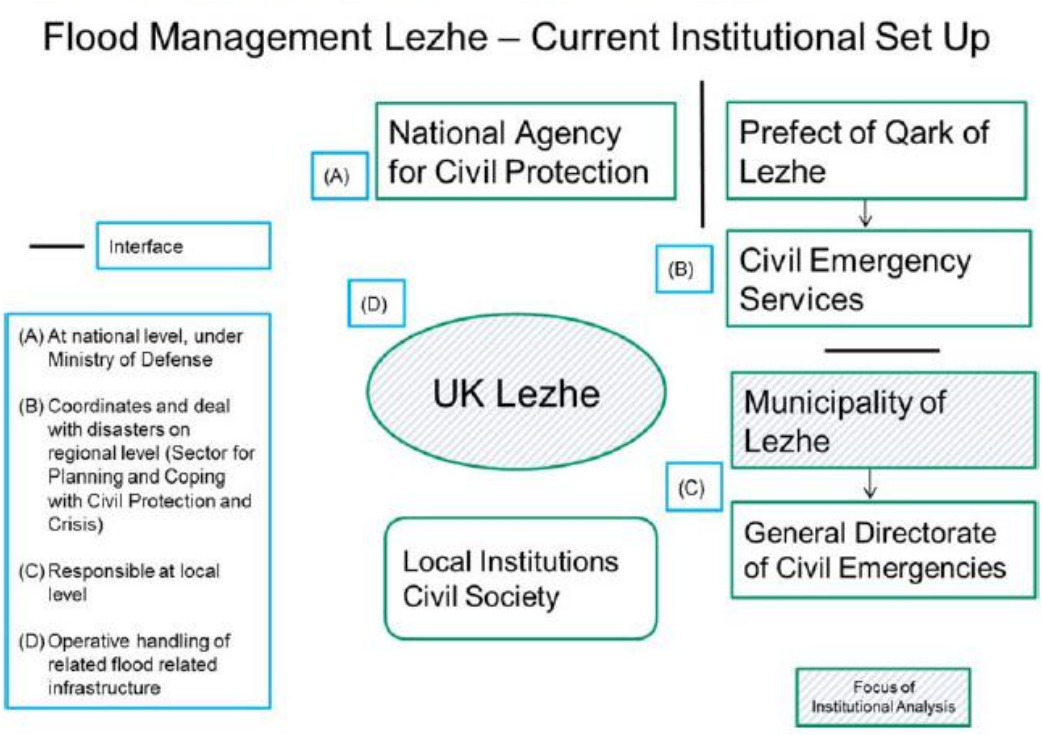


Fig 1: Current institutional set up of flood management in Lezha

The Feasibility Study (FS) of the WPIP/MIPV project proposes a **future Institutional Set Up** designed to achieve a more effective institutional balance of the multiple tasks associated with DRM in the city Lezha.

A written agreement could be established between the municipality and UK Lezha:

The proposed institutional set up can be realised under the existing national and regional framework, which needs not to be changed.

The legal obligations in dealing with flood management clearly falls under the responsibility of the municipality. However, certain task can be devolved to UK Lezha. This applies especially to the tasks of operation and maintenance of the flood related infrastructure. UK Lezha can also contribute to other tasks such as raising public awareness and flood forecasting/modelling. The agreement should include the modalities of financing the stormwater operations, if possible.
The main features of the proposed set up are the following:

The municipality would be responsible at local level for

- Land Planning
- Building Regulations and Permits
- Enforcement of Regulations
- Coordination of Disaster Response

UK Lezha would assume the functions of

- Operative handling of flood related infrastructure
- Flood Modelling
- Operation and Maintenance of relevant infrastructure

This institutional set up, as well as the distribution of the tasks will be discussed further during the next phase of the project, especially with the municipality and UK Lezha.

Organization chart

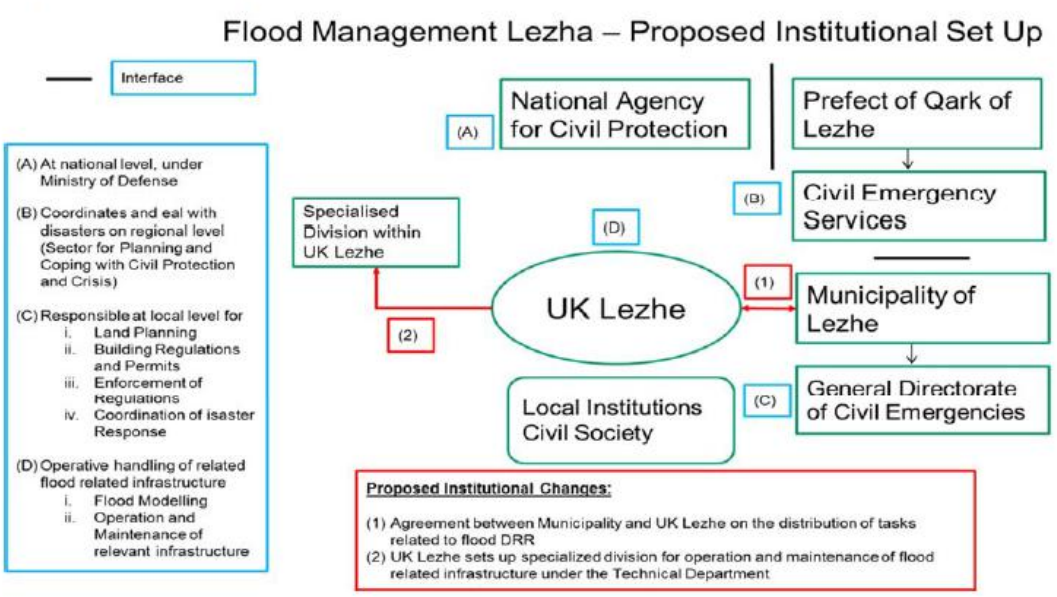


Figure 2: Proposed institutional set up of flood management Lezha.

This proposed future institutional set up as presented in Figure 2 was introduced to the municipality, the District and UK Lezha. All institutions confirmed this in an agreement (see annex 11 FS).

1.4 Planning process

One of the key stone for planning a Flood emergency response is **the ability to develop a fast a comprehensive PDNA – Post Disaster Need Assessment.**

In July 2019, Albania approved a new law on civil protection, which presents a modern and progressive approach to DRM. Among many key actions, the law requires that risk assessments have to be carried out at national, provincial and local level at least every three years; institutions and private entities have to provide data on disaster losses, and a disaster loss database has be established. While disaster risk assessment and loss data collection have been performed in Albania for many years, the obligations under the new law formalize the requirements and responsibilities of the involved parties and aim to ensure that the resulting information is pro-actively used to prioritize, plan and implement DRM.

Gap analysis

A gap analysis in the report **Improving disaster risk and loss information in Albania** – 2022 of the World Bank Group considered several aspects related to risk data management, disaster damage and loss assessment process in Albania. It was observed that almost three years after the enactment of Law 45/2019 On Civil Protection, many of the prescribed reforms and initiatives have not occurred yet and local authorities and national institutions still face several challenges in meeting their responsibilities defined by the Law. Expertise and tools are spread across different institutions, who do not seem to be collaborating efficiently or consolidating the governmental units that should oversee the data collection process and the maintenance of databases for damage and loss after natural or man-made hazardous events. Municipalities' capacity is also insufficient for the key role they are expected to play in the risk assessment, in drafting local emergency plans, in the post-disaster data collection and loss assessment, in the development of investment plans for disaster prevention, protection and rehabilitation, in managing monitoring and early-warning systems and similar. Moreover, the prefectures (qarks) are responsible for providing risk and loss related data to the National Civil Protection Agency (AKMC), who shall establish and operate the National Disaster Losses Database. According to the Law, risk and disaster loss data shall exist at three levels - municipalities, prefectures, ministries and central institutions - and shall be managed on a national level by AKMC.

DesInventar: conceptual and methodological tool for PDNA

In practice, an integrated national digital database for risk-related and post-disaster data with a clearly defined structure, standards and IT infrastructure for *collection and processing of data is not available. The National Geoportal,* developed and operated by ASIG, is currently the digital database for georeferenced information but still seems to be in its initial phase of structuring and harmonization, with a rather limited number of datasets and functionality that need improvement. The Geoportal contains datasets useful for hazard and risk assessments, but the data is still insufficient for the development of risk models and completion of full-scope multi-hazard risk assessments. **As for the disaster data, the only unified database currently used in Albania is *DesInventar Sendai*,** *which contains summaries of the consequences after events. The use of DesInventar, however, is not regulated by Law 45/2019 or related legislation, thus the rules for update and data entries are not defined.* Separate disaster reports are occasionally prepared, communicated and stored by municipalities and prefectures but they are not systematically collected and managed across all municipalities.

DesInventar: a conceptual and methodological tool for the generation of National Disaster Inventories and the construction of databases of damage, losses and in general the effects of disasters. Developed by UNISDR. The DesInventar Sendai system is in use in Albania as the Methodology for post-disaster data collection and analysis since 2022.

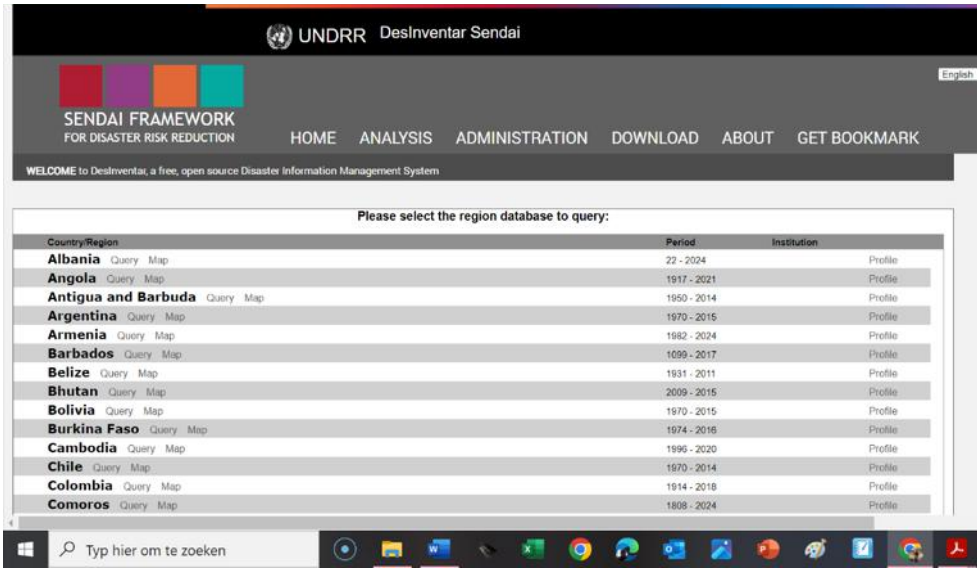


Figure3:Database-Desinventar;https://www.desinventar.net/DesInventar/index.jsp

The proposed methodology combines different approaches and can be used for different types of disasters by adjusting the scope and the steps based on the specifics of the hazardous event.

One's you get your member's login; the different steps of the methodology are structured along a timeline from the moment a catastrophic event occurs to the completion of the recovery strategy. The methodology workflow follows 21 parameters to be splitted into four groups: Hazard identification and characterization; Identification of the affected area; Preliminary post-disaster assessment and loss estimation; and Full-scope post-disaster assessment and loss estimation.

Post-disaster data collection is split in two parts: 1) "desktop" search for data sources and gathering data from remote sensors and satellites; and 2) on-site surveys and reconnaissance. The "desktop" data collection can start immediately after the disaster and helps the immediate response. The on-site surveys, however, usually start after the initial search and rescue phase. This of course depends on the scale of the impact but, in any case, some time will be needed for mobilisation and planning of the survey activities.

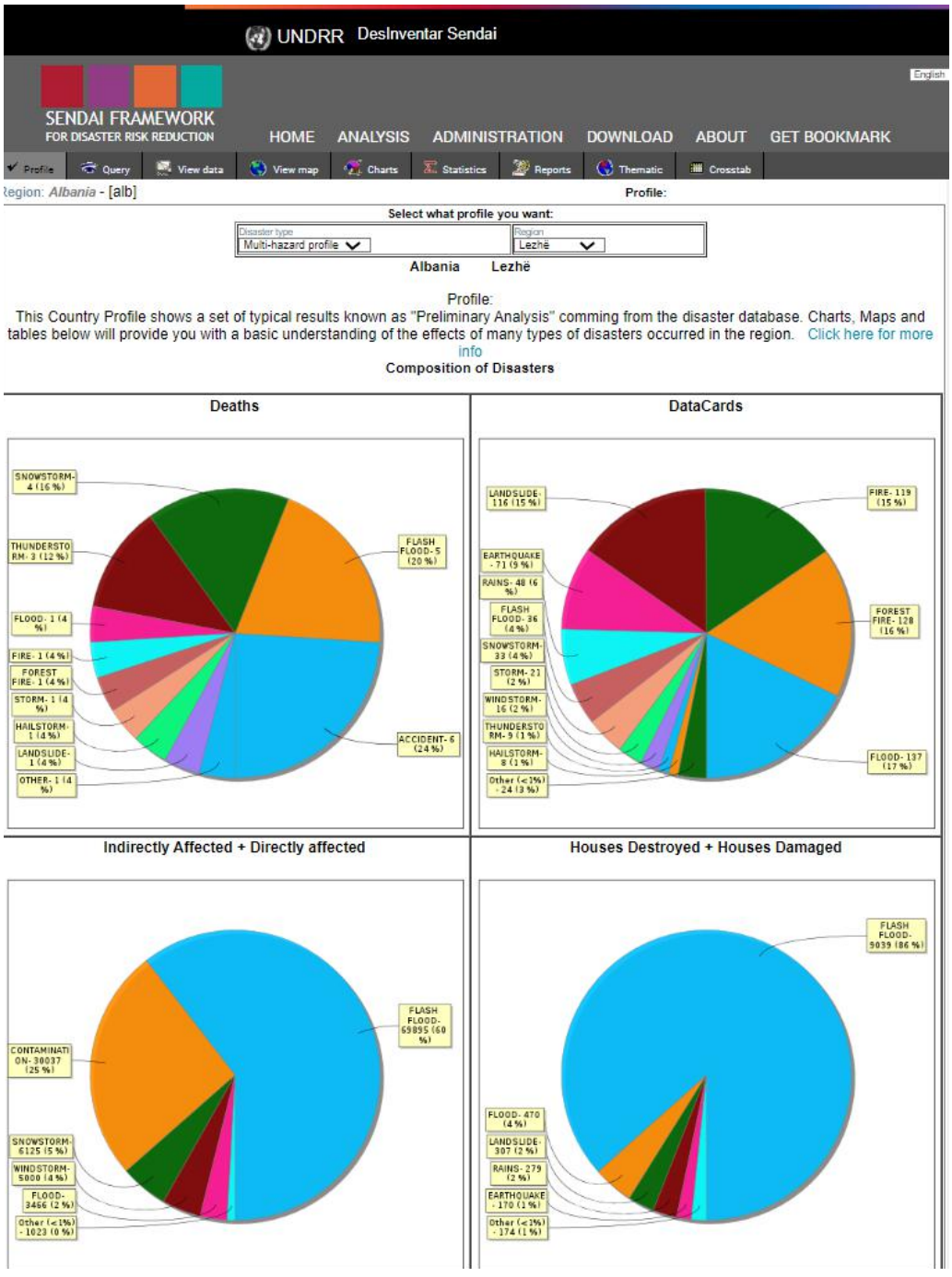


Figure 4: Data collected for Lezha

Above (Figure 4) is a screenshot depicting the historical data collected for Lezha. You can view it under https://www.desinventar.net/DesInventar/profiletab.jsp. The data clearly indicates that flooding and other water-related hazards have the most significant impact on the number of affected people and on housing in the area.

The World Bank Group assessment report **Improving disaster risk and loss information in Albania** – 2022 (financed by the Government of Japan and managed by the Global Facility for Disaster Reduction and Recovery (GFDRR) formulate 37 recommendations to contribute to build improved DRM decision-making tools based on Desenventar in Albania. By improving the national disaster risk and loss information, the availability and accessibility of multi-hazard risk information will become quicker and the development of emergency need response to cope with natural disasters would become more efficient.

1.5 Reference legal framework

Institutional framework.

One of the basic principles of law 139/2015 "On local self-governance" is' Subsidiarity ', which is 'the principle of performing functions and exercising competencies at a government level as close as possible to the community, given the importance and nature of the task, as well as economic efficiency requirements' (Assembly of the Republic of Albania, 2015). In this context, based on article 29, the municipality, as a local authority, has direct competencies in the field of civil protection, which are subsequently granted by the sectoral legislation. Law 45/2019 "On Civil Protection" aims to reduce the risk of disasters and the implementation of civil protection, to guarantee the protection of human life, property, livestock, cultural heritage and the environment, through the strengthening of the civil protection system (Assembly of the Republic of Albania, 2019). The law states that the mission of civil protection is to create the conditions for a society capable of coping with various disasters and thereafter being able to recover, through the establishment of an integrated and efficient civil protection system in the Republic of Albania. This law has introduced a number of innovations in the field of civil protection in Albania, both from the institutional point of view and from the instruments used to achieve the goals. It proposes three main instruments to be used at both national and local level, namely: a risk and vulnerability assessment document, a risk reduction strategy, and a civil emergency plan.

The National Agency for Civil Protection, currently functioning under the Ministry of Defence, is the main body at national level to exercise civil protection duties and to prepare the aforementioned instruments. The prefect of the 'Qark' has specific duties based on law 45/2019. These tasks include coordinating the activities of bodies, institutions and structures operating at the 'Qark' level, and collecting and processing the necessary data from municipalities and other structures. In addition, the Prefect ensures the coordination and distribution of international assistance in cases of disasters, and controls the implementation of measures taken by the municipalities. Meanwhile, at the local level, according to law 45/2019, municipalities have several responsibilities, such as informing the public and the endangered community, and organizing training activities in the field of civil protection for employees and residents in their territory. In addition, municipalities provide, administer and update the necessary data for citizens and private entities that will engage in the prevention and coping of disasters, make preventive, protective and rehabilitative investments from disasters and appoint the

head of the operation at municipal level. Based on the above law, all municipalities are obliged to establish as part of their structures the respective directorate of civil protection.

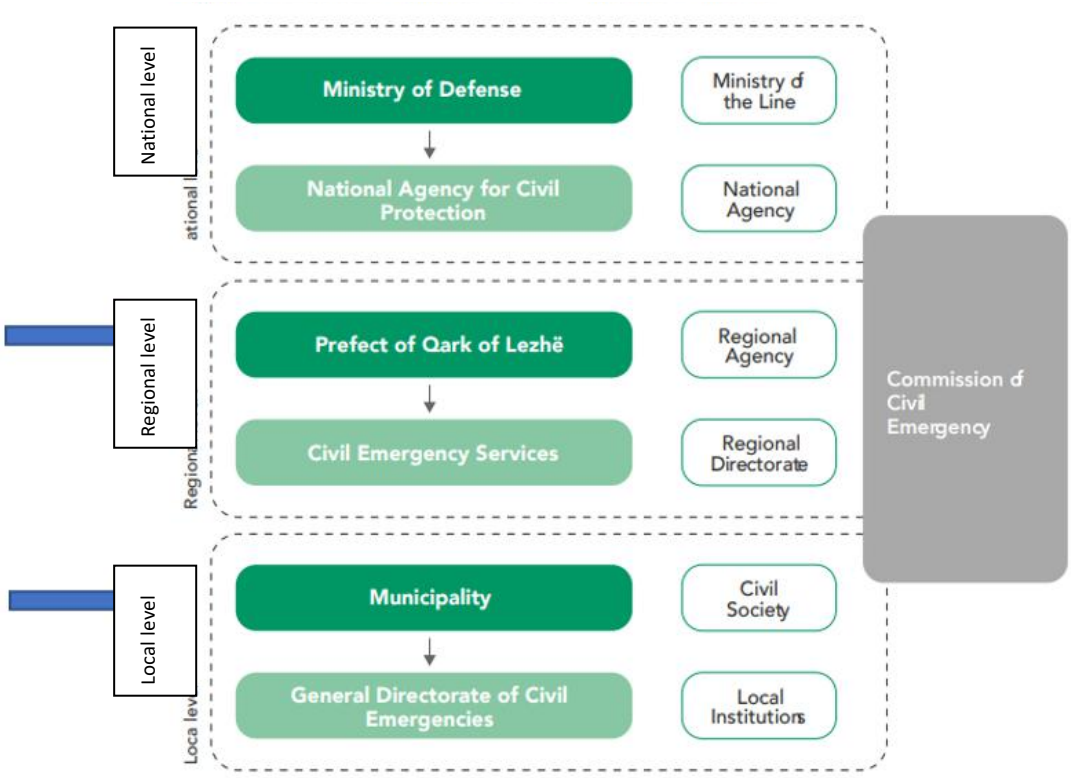


Figure 5: Institutional Framework for Civil Protection in Albania. Source: Preparation of the local disaster risk reduction plan for the municipality of Lezha: UNDP. April 2020

The arrows illustrate the levels at which the project contributes to the development of DRM measures in Lezha. Of particular importance for understanding the legal framework of emergency planning in Albania is decision No 532, dated 1.8. 2003 On LIABILITIES AND TASKS OF THE CIVIL EMERGENCY PLANNING AND RESPONSE DEPARTMENT. Article 1.b makes clear reference to the NCEP clarifying *that "Drafting plans for completion and updating of reserves of civil emergencies should be done in complia nce with the national plan of civil emergencies".*

The NCEP clearly states that *"it is the responsibility of authorities at Qark, Commune and Municipal levels to develop contingency plans of their own, which all feed into the National Civil Emergency Plan, and the procedures, roles and responsibilities which it describes.".* The Prefect undertakes these efforts by establishing the Qark Commission for Civil Emergency Planning and Response which will articulate plans and the overall response at prefectural level. Moreover, the NCEP also calls for a more efficient Early Warning System (EWS) by stating that:

"It is the responsibility of the Department for Civil Emergency Planning and Response and concerned local authorities, to ensure that all stakeholders are conversant with the local and national early warning systems and necessary contacts and procedures. It is also the responsibility of the civil emergency structures at central level and designated civil emergency officials at Qark, Commune and Municipality levels, to ensure that timely and appropriate warning messages are broadcast to the public and institutions, advising them of the risk and the necessary steps for them to take."

According to the NCEP, in fact:

Early warning is duty of all the responsible structures starting from local up to the central level and of the specialized structures.

Table 3: International guidelines

International guidelines/tools
UNISDR Disaster Resilience Scorecard
WMO - Multi-Hazard Early Warning Systems (MHEWS), Good Practices and related guidance principles
IASC Cluster Approach Evaluation, 2ND phase April 2010
EU guidelines/directives
Risk Assessment and Mapping Guidelines for Disaster Management SEC (2010) 1626 final
EU Floods directive 2007/60 EC
EU WFD 2000/60 EC
EU Risk Management Capability Assessment Guidelines (2015/C 261/03)

2 Geographical context

The City of Lezha is located on the low-lying floodplain of the Drini River approximately 60km north from Tirana. It is located within a mainly agricultural area. It is bordered to the east by natural forests and to the west by coastal lagoons and the sea.

Figure 6 – Location of Lezha Municipality ***(source: Wikipedia)***

It is the largest city and the economic and administrative center of Lezha. The Region has a permanent population of approximately 31,000 inhabitants.

Land use comprises a quite dense urban development within the city, spreading to less dense developments further from the center, which blend into the agricultural areas north and south to the city. On the east side you find the castle hill that merge further into mountainous areas that are forested and largely undeveloped.

The main city center of Lezha is confined to a roughly triangular low-lying area bounded by the heights of Lezha Castle to the north east, Drini River to the west and Manatia Stream to the south.

The Drini River and Manatia Stream act to separate the older city center with newer developments west and south of the city. New developments within the city are generally taking place on brownfield sites as there is virtually no undeveloped or unoccupied space in the city center. As the Lezha city population expands, areas close to the city on the opposite banks of the Drini River and Manatia Stream are seeing a change from agricultural land use to urban residential and commercial purposes. Notable areas where these developments are occurring are the SMT area to the south and to the west Frutore.

The Drini River itself has been rehabilitated in recent years and now features flood levees protecting both east and west banks of the river, which have been incorporated into pedestrian walkways and cycle paths.

Flooding in Lezha city is a frequent occurrence, with a reported frequency in some areas of up to 6 times a year. Flood depths in the town center are generally shallow (max 30-50cm) and flow velocities low. Rainfall on the Castle hill quickly collects as surface runoff that is funneled down the hillside roads and toward the city center, adding local storm water runoff of the city itself. Floodwaters can linger for many hours as there is generally no possibility for gravity drainage. Therefore, evacuation of the excess stormwater must rely on the combined sewer network pumps (with capacity problems during peak inflows).

The aim for developing a flood emergency respond scheme is that flooding is far from an unforeseeable event. Flood risk is something that can be estimated, with varying degrees of uncertainty, and its effects are generally predictable. This means that the **impacts can be significantly mitigated, and response and recovery can be organised more effectively**.

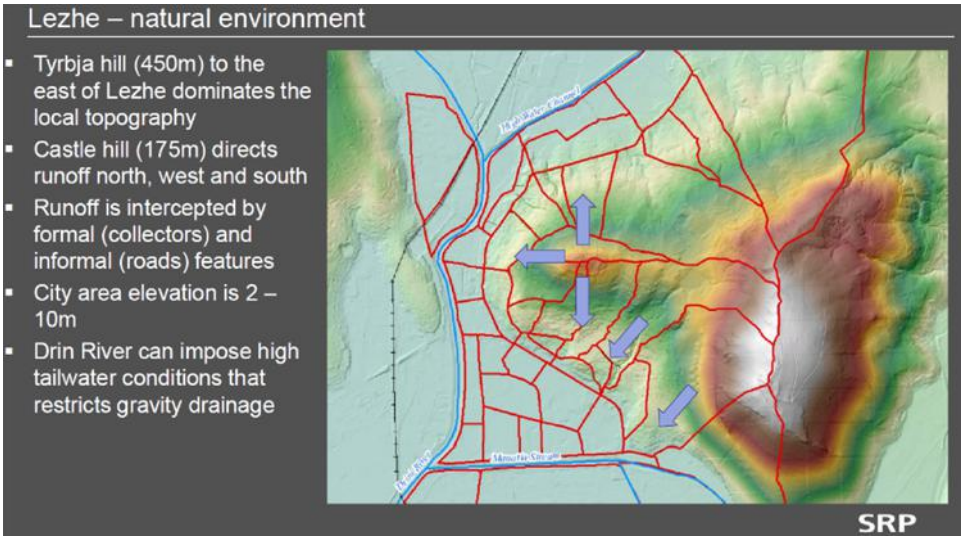


Figure 7: Storm water runoff Lezha

Flooding in Lezha, Summary

The main causes of flooding within the city can be summarized as follows:

- Stormwater infrastructure required to collect and channel hillside runoff via gravity to the adjacent waterways is either non-existent or in state of disrepair (damaged and/or blocked channels and culverts).
- Consequently, a large proportion of the stormwater runoff flows overland (down roads and paths) towards the city, where the existing combined sewer network does not have sufficient capacity to handle more than a 100% Annual Exceedance Probability (AEP) event (Ref. SETEC 2013).
- Sediment access existing drainage network (both combined sewers and stormwater culverts) which further reduces system capacity.
- There is no provision for combined sewer overflow at Besalidhja, and therefore the only possible means of evacuation of the combined waste and stormwater flows is via the pump station which does not have the capacity to handle such high inflows.

Due to pipe blockages and limited capacity of the existing sewer network, surface flows which cannot enter the network, is collected in the lower lying areas of the city, these being:

- the area south of Park 11 Janari
- along Rruga Kosova near the high school
- around Apartment “11.2 Ha” (off Rruga Franz Josef Strauss),
- in Varosh Gurra (located immediately opposite the intersection with the new hospital road)

Economy

In former times, the Lezha District was an area with a predominantly industrial economy (mines, food industry, chemical industry, etc.) supported by agricultural activities. Due to the socio-economic changes in the 1990's, the role of industry in the region's economic development began to decline. Today, agriculture, tourism and fishing are important activities, concentrated mainly in the western area of the district, where fertile lands with high productivity are located as well as the coastline which is attractive for tourism. Consequently, a population migratory movement from the eastern part of the district towards the west started after the 1990s, causing a considerable reduction of the population of the various settlements, whose economy was based on industry. Conversely, the population of Lezha Shengjin and Shenkoll increased during the 1990s and 2000s. The growth of permanent populations has now levelled out, but the number increases due to tourism seasonally.

3 RISK SCENARIOS

3.1 Methodologies

Risk is given by the product of a certain hazard and a given human dimension, characterized in terms of vulnerability, exposure and capacity. Therefore, risk assessment involves the following steps:

- Hazard assessment.
- Identification and characterization of exposed elements.
- Vulnerability and capacity assessment.
- Combination of previous steps and determination of the risk.

The three main steps in the assessment of flood risk are the following:

1. Assessment of the sources of flooding, quantification of the flood risk and its consequences – **risk identification**
2. Establishment of risk management objectives – **risk analysis**
3. Determination of the best approach to achieve the objectives by identifying measures and prioritizing – **risk evaluation.**

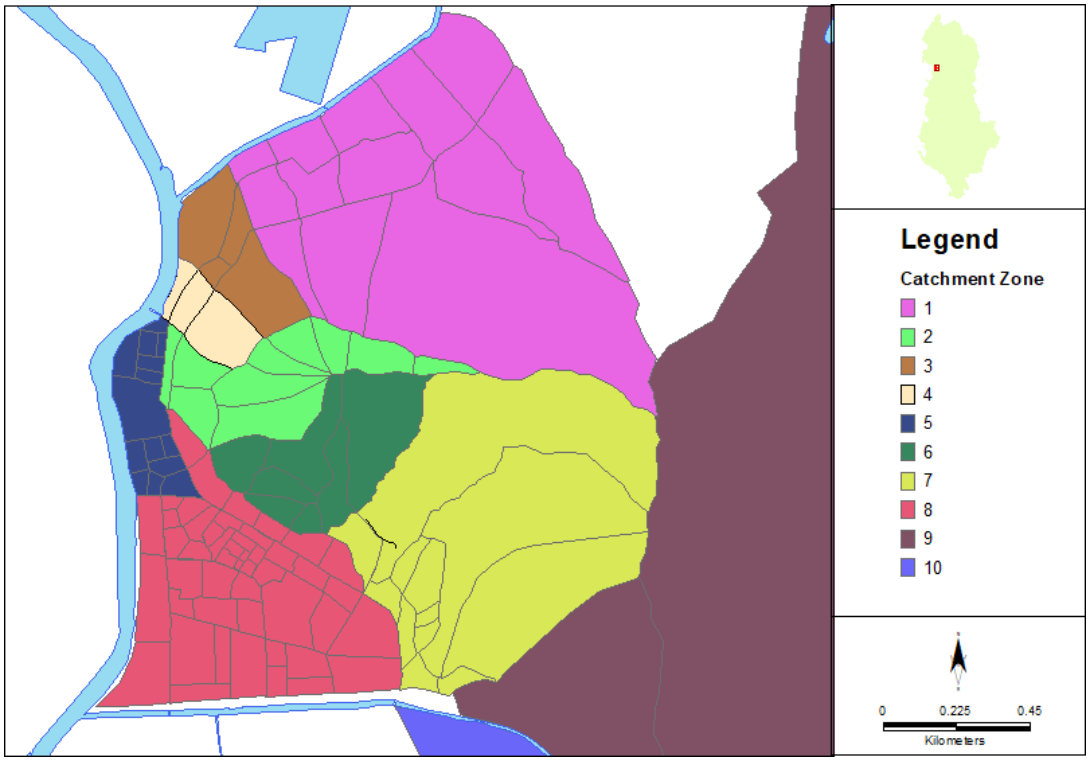
3.2 Flood Hazards and Risks Considered

The EUFD requirements in terms of flood mapping (Article 6) are as follows.

Flood Hazard maps, for three different scenarios representing low, medium and high probability of flood events, indicating the flood extent, depth, level, and velocity or flow.

Flood Risk maps showing the potential adverse consequences in terms of indicative populations at risk, type of economic activity affected, and impacts on the natural environment and heritage, including potential sources of pollution during a flood event.

3.2.1 Risk identification.



Flooding in Lezha can origin from main sources as follows:

River Flooding (termed "fluvial") occurs when catchment runoff in natural streams and rivers exceeds the capacity of its channel, resulting in overflowing of the riverbanks leading to inundation of the low lying adjoining floodplains. Areas, which are often favored for urban development and agriculture due to the flat terrain and rich alluvial soils. *River flooding is discussed in more detail in Section 4.2.3.*

Coastal Flooding occurs when sea levels rise above normal conditions, due to a combination of high tides, low pressure systems and strong winds and associated waves, resulting in storm surge conditions. Storm surges along the coast near Lezha do not cause coastal flooding due to protective embankments that have been constructed but they do affect river levels at the mouth of the Drini River which subsequently affect river levels in Lezha.

Surface Water Flooding (termed "pluvial") occurs when heavy rainfall overwhelms man-made or natural drainage systems, resulting in an accumulation of water on the surface seen as ponding

and overland water flow. Urban areas are most prone to this type of flooding due to the high shares of impervious surface. Surface flooding is the main source of flooding in Lezha and the causes are described in more detail in the following.

3.2.2 Risk Analysis

General Problem Description

Surface water flooding in Lezha city is a frequent occurrence, with a reported frequency in some areas of up to 10 times a year. The reasons are due mainly to the geography of the town. Located on the Drini River floodplain, the main part of the city center has a very low relief, with land levels in the range of 2.0 – 3.0m above sea level. However, the city is also located at the foot of the 175m high Castle hill, which slopes steeply down to the city, which is therefore exposed to rapid and concentrated surface runoff during rainstorm events.

The hydrological behavior of the catchments draining the city, Castle hill and Manatia Stream catchment to the east is visualized in the drawing shown in Figure 8 and summarized in Table4.

Figure 8: Lezha Catchment Runoff Zones

Zone	Area (ha)	Hydrological Description
1	88.3	Steep catchments drain to the High-water channel upstream and north of Lezha which do not affect the city
2	17.6	Represents the Castle hill catchment directly above R. Varosh (Castle hill road). Overland flows from the steep hill catchments above the road are intercepted and flow down the road toward R. Frang Bardhi. A portion of the flows then travels south toward the city centre contributing to city flooding.
3 and 4	9.9	Steep hillside catchments that discharge into R. Frang Bardhi, causing local flooding
5	5.3	Flat urban catchments that drain via the existing combined system to the pump station at Skanderbeg memorial. These flows are further pumped to the main pump station at Besalidhja. Regular flooding occurs around the Skanderbeg memorial excavations
6	8.3	Hillside collectors drain the south side of Castle hill toward the city centre. Overland flows down Old Hospital Road spill onto Boulevard Gjergj Fishta and turn south collecting around the High School. All flows entering the city centre can only be evacuated by the existing Besalidhja pump station.
7	18.3	Steep hillside catchment above the new hospital, drains by gravity via a culvert on Boulevard Gjergj Fishta to Manatia Stream.
8	65.7	Main city centre catchment (flat, but with 50% impervious surfaces), drains via the combined sewer system to the existing Besalidhja pump station which transfers the flows to the WWTP.
9	44.8	Large (2400ha) and steep catchment that drains to Manatia Stream
10	2092.8	Main catchment feeding Fidana Stream, which joins Manatia Stream just south of Lezha city centre.

Table 4: Description of catchment areas.

Rainfall on the Castle hill quickly collects as surface runoff that is funneled down the hillside roads and towards the city centre, adding to local stormwater runoff within the city itself. The city center area is highly developed, with over 50% of its surface covered by impermeable materials such as roads, parking garages, roofs, and sidewalks. This extensive impermeability means that intensive rainfall leads to significant amounts of surface runoff. Natural gravity drainage of surface water runoff in the city is restricted from entering the Drini River due to the river flood embankment and periodically high river levels. Therefore, evacuation of the excess stormwater must rely on the combined sewer network which suffers from capacity constraints and blockages caused by the ingress of sediments swept from the hillside. Further the combined sewer system only drains by pumps which do not have the required capacity for the observed peak inflows. Therefore, surface floodwaters can linger, often for more than 24 hours. Although flood depths in the town centre are generally shallow (30-50cm) and flow velocities are low, flooding occurs frequently (10 times a year) continues to cause physical damages as well stressful situations for the affected residents and businesses.

Flooding Hotspots and Causes

The two main areas affected by flooding in Lezha are the (i) Skanderbeg area, north of the main road bridge, and (ii) the main Lezha city area south around the Besëlidhja stadium.

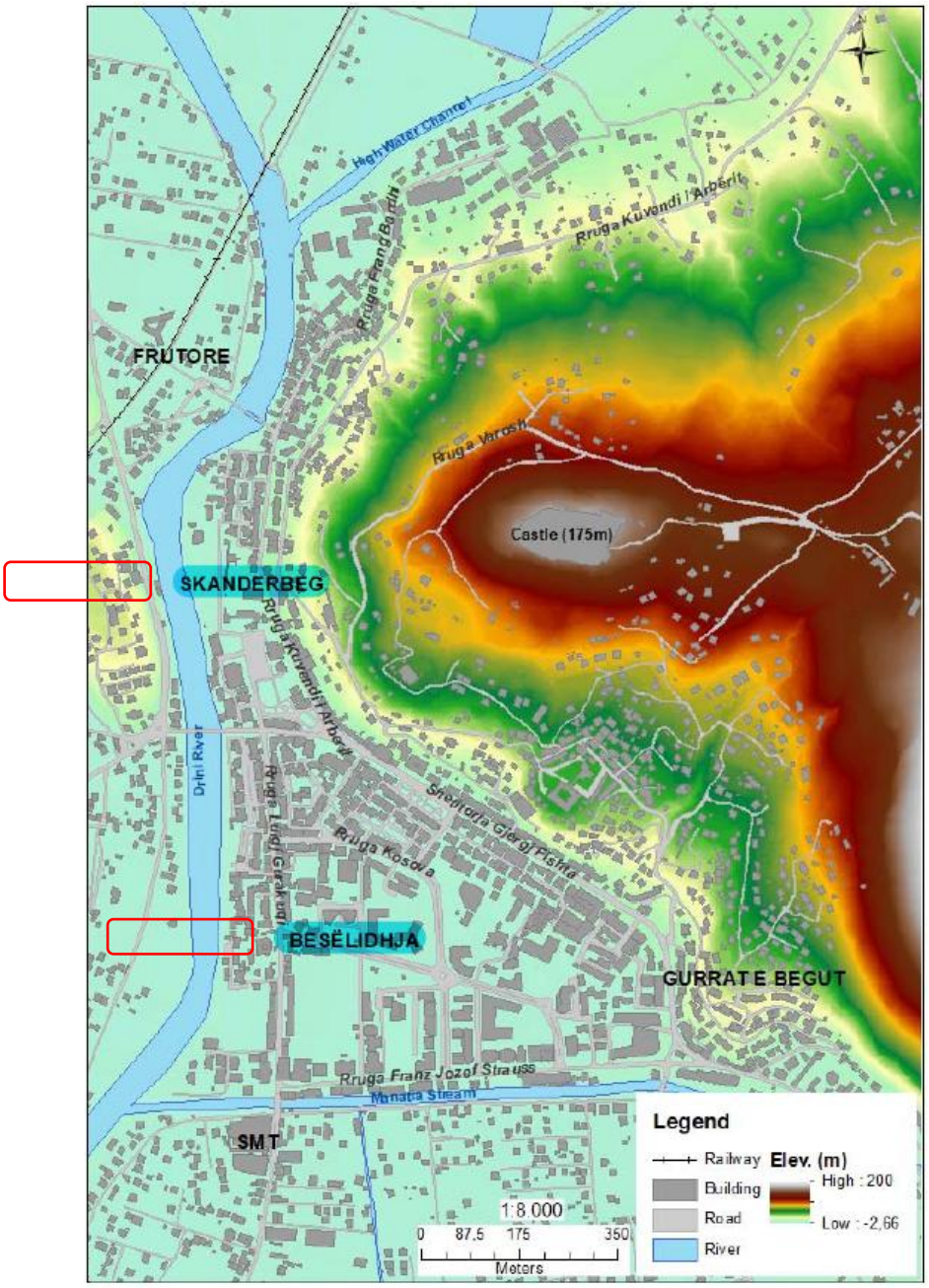


Figure 9: flooding hot spots Lezha: Skanderbeg and the city center Besëlidhja stadium area.

1. Skanderbeg area

The Skanderbeg area lies in a narrow strip between the foot of Lezha Castle hill and the Drini River. It extends for approximately 850 meters north from the main Drini Bridge Road bridge. The area is served by two main roads which run roughly parallel along the foot of the hill, Rruga Kuvendi i Arbërit on the upper slope of the hill and Rruga Frang Bardhi on the lower slope. Both roads are

served by combined drainage systems, however they are severely affected by blockages from gravel and rubbish.

Runoff from the hill slope is channeled toward the Drini River via three main drainage lines, which comprise small open channels, transitioning into covered drains upstream of Rruga Frang Bardhi. The covered drains have in some cases been repaired but are in a poor state with very little capacity. As a result, the majority of surface runoff drains via overland flowof roads and small alleyways that separate the houses, causing surface flooding, before draining into Drini River.

2. Lezha City Centre

The center of Lezha resembles a roughly triangular area situated south of the main Drini River bridge. It is delimited by the river to the west, the Manatia stream to the south, and the Castle hill to the north and east. Flooding in Lezha city stems from inadequate drainage capacity due to undersized and/or blocked combined sewer pipes and stormwater culverts, coupled with insufficient pump capacity to manage stormwater runoff. Overland flows originate from both hillside catchments draining toward the city center and locally generated runoff resulting from the impervious nature of the city area itself.

Three primary locations serve as points of diversion for hillside flows into the city area (Figure 10):

1. The junction of Rruga Varosh and Rruga Kuvendi i Arbërit.

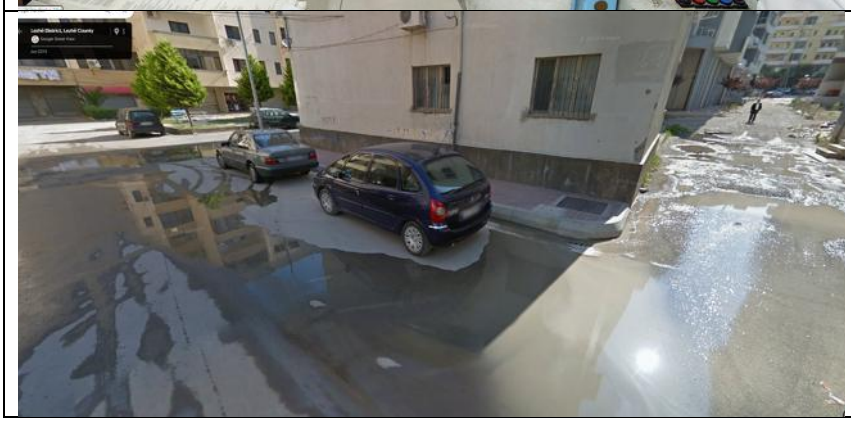
2. The junction of Old Hospital Road and Blvd. Gjergj Fishta.

3. New Hospital Road.

Refer to the next pages for visual representations of these locations.

The yellow spots represent culverts designated for water evacuation. However, their capacity is hindered by blockages caused by fine gravels and sediments accumulating at the grate entry points. This restricts the entry of stormwater into the culverts, thereby limiting their effectiveness in managing water flow.

Figure 10: Diversion for hillside flows into the city area.

		Junction of Rruga Varosh and Rruga Kuvendi i Arbërit. The capacity of the culver is hindered by blockages caused by fine gravels and sediments accumulating at the grate entry points.
		Paper shop at Junction of Old Hospital Road and Blvd. Gjergj Fishta. People protect themselves against water damage by placing their belongings on a raised surface so that they are protected from water.
		Area of Junction of Old Hospital Road and Blvd. Gjergj Fishta. At the slightest rain, water remains in the streets here.

	Area of Junction of Old Hospital Road and Blvd. Gjergj Fishta. Traces of water damage on houses.

Figure 11: Visual impressions of described locations:

Due to uncontrolled inflows from hill catchments, coupled with significant stormwater runoff from within the city and exacerbated by the poor condition of the drainage infrastructure, Lezha frequently experiences surface flooding, particularly in concentrated areas:

Park "11 Janari" in the "Besëlidhja" neighborhood serves as a low point in the city and is among the first to be inundated during regular storm events (refer to Figure 12). It acts as a natural collection point for overland flows originating from western and southern hill catchments (Zones 2 and 6 in Figure 8, via the described routes 1 and 2) that exceed the capacity of the sewer network. Residential properties are typically the first to be impacted, and during more significant events, surface flow extends south toward Rruga Kosova, affecting commercial establishments and occasionally encroaching upon the high school grounds.

Figure 12: Lezha, March 2024. January 11 residential block in the "Besëlidhja" neighbourhood.

Varosh Gurra experiences excess flows from New Hospital Road, which spill across Blvd. Gjergj Fishta, as detailed in section C above.

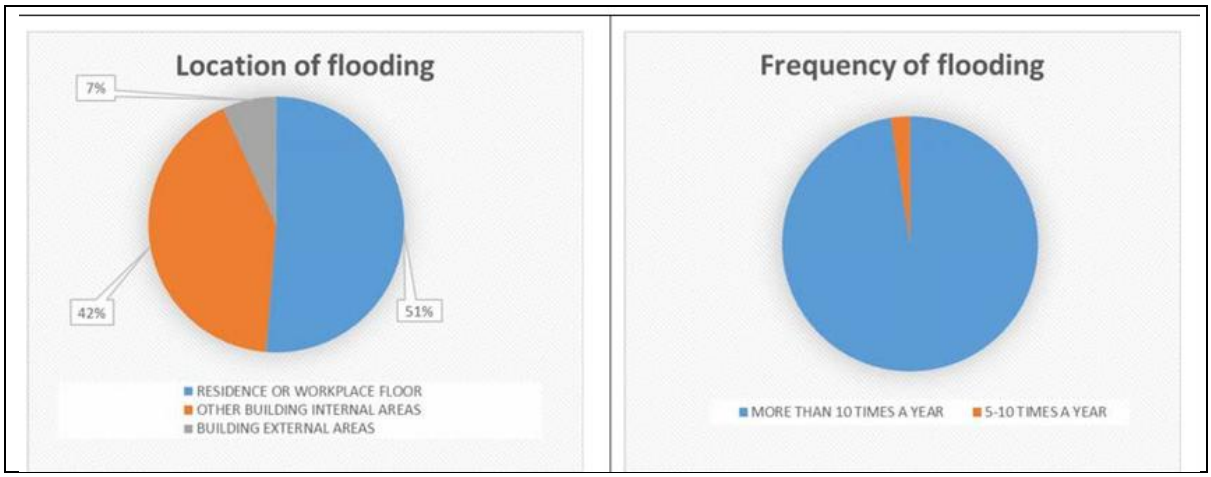
Stormwater runoff naturally gravitates westward in this area, converging at a local depression around Apartment "11.2 Ha". During more severe rainstorm events, flooding from Apartment 11.2 Ha and Park "11 Janari" combines, resulting in a continuous line of inundation along Rruga Kosova.

Flood survey.

With the assistance of UK Lezha, a detailed flood survey was conducted in 2019 of many floods affected residents and businesses within the regularly flooded areas of the city, which provides a picture of the impacts of the current flood situation. The survey took place in the form of a questionnaire that was distributed to residents along with their rates bills, and the responses were compiled by UK Lezha.

The main findings of the survey are summarized below and illustrated in Figure 13::

- Flooding areas affected were primarily within the residence or workplace buildings themselves.
- The vast majority stated they were affected more than 10 times a year by floods, with the duration of flooding exceeding 24 hours 93% of the time, and not less than 6 hours.
- The depth of flooding on each occasion was over 50cm 36% of the time, and not less than 20cm.
- The source of the flood was approximately equally divided between roads, nearby drains and manhole surcharging.



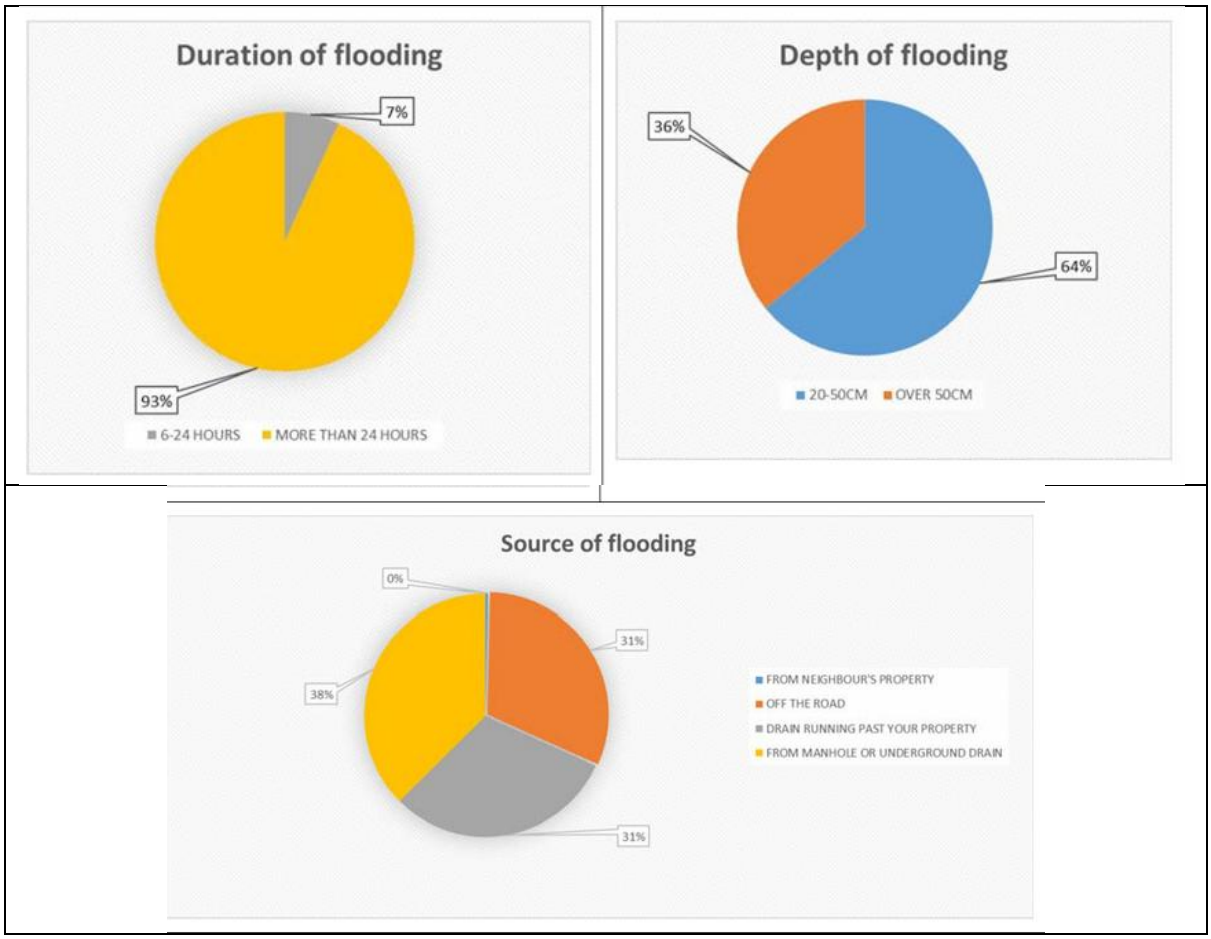


Figure 13: Main findings of the survey on flooding in Lezha

Summary of flood risk analysis

The primary causes of flooding within the city can be succinctly summarized as follows:

1. Absence or deterioration of stormwater infrastructure designed to channel hillside runoff by gravity into adjacent waterways, often due to damaged or blocked channels and culverts.

2. Consequently, a significant portion of stormwater runoff travels overland, following roads and pathways toward the city. However, the existing combined sewer network lacks the necessary capacity to accommodate events exceeding a 100% AEP).

3. Sediment infiltration into the existing drainage network, comprising both combined sewers and stormwater culverts, further diminishes the system's capacity to manage water flow.

4. The absence of a provision for combined sewer overflow at Besalidhja necessitates the evacuation of combined waste and stormwater flows solely through the pump station. However, the station lacks the capacity to handle such high inflows effectively.

5. It is generally a relatively small area that regularly floods - up to 10 times a year - causing economic damage to the affected families. Due to pipe blockages and limited capacity of the existing sewer network, surface flows which cannot enter the network collect in the lower lying areas of the city, these being:

- the area south of Park 11 Janari
- along Rruga Kosova near the high school
- around Apartment "11.2 Ha" (off Rruga Franz Josef Strauss),
- in Varosh Gurra (located immediately opposite the intersection with the new hospital road)

The estimated annual damages provided by the respondents is summarized in Table 5. The total annual damages amount to 38m Lek.

Category	No.	Structural damage	Fittings and furniture	Loss of income	Total annual damage ('000)
Residents	33	157	157	n/a	10,362
Institutions	6	150	150	n/a	1,800
Businesses	91	160	160	77	36,127
TOTAL					37,927

Table 5: Estimated annual damages ('000 Lek) provided by flood survey respondents (survey UK Lezha 2020)

3.3 Hazard, Exposure and Risk Maps

A quantitative assessment of the existing flood risk related to surface water flooding has been undertaken through the use of hydrological and hydraulic modelling, which has been used to map the spatial extents and depth of flooding in the city.

The Municipal Infrastructure V Project aims to revolutionize the Sewerage and Stormwater management system of the city of Lezha. It seeks to introduce conceptual changes to optimize the drainage of stormwater from neighbouring hillsides, thereby mitigating the frequent flooding events in the city center. However, due to logistical constraints, the complete conversion of Lezha's sewer network into a separate system cannot be achieved all at once during the current implementation phase.

The main target of the concept is to drain the accruing stormwater flow from "high level areas" (at the hillsides) via stormwater culverts in gravity flow to the Drini River, respectively to Manatia Stream.

Only stormwater originating from the city centre of Lezha will be directed to the main stormwater pumping station (lower catchment area).

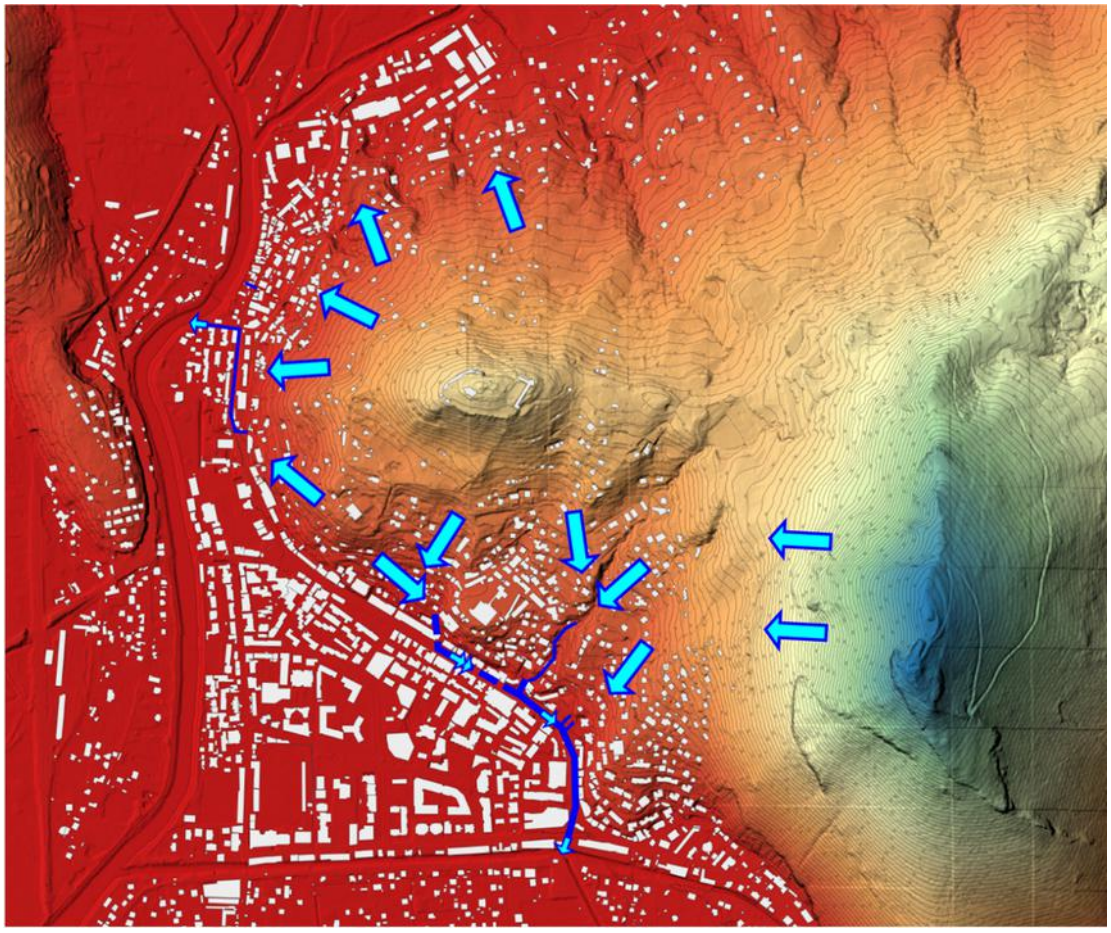


Figure 14: Terrain map of Lezha with deviation concept of surface discharge

One advantageous outcome of diverting stormwater away from the city center is the possibility to create manageable and practical stormwater pumping station in the center of the city, capable of handling approximately 3m³/s of stormwater volume. To address the challenge of sand, gravel, and waste accumulation in hillside stormwater flows, a range of Gravel, Sand, and Waste traps, along with high-performance inlet structures, have been designed. These measures are crucial for facilitating the smooth passage of heavy rainfall runoff into the sewer system, thereby enhancing operational safety and ensuring the ongoing feasibility of sewer cleaning efforts.

Separation of stormwater and wastewater

The Municipal Infrastructure V Project undertakes a comprehensive revision for the entire stormwater and wastewater infrastructure. The design of both systems is now intricately interconnected, with the stormwater system serving as the foundational framework upon which the sewerage system is

planned. Consequently, the initial step involves designing a unified system, with sewerage pipes running alongside stormwater pipes and culverts, either through new construction or by rehabilitating existing sewers. Functional sections of the existing sewer network will be seamlessly integrated into the new system, while inadequate sections will be replaced.

Given that Lezha's city center is already serviced by numerous sewerage lines lacking design or as-built information, an immediate transition to a purely separate system is unfeasible. As a result, parts of the city center will temporarily retain a combined sewer system, with gradual transformation into a separate system envisioned for the future. Accordingly, the newly designed sewer system is engineered to accommodate a certain volume of rainwater, reflecting a modified approach.

During the transitional period until the complete conversion to a separate system is realized, stormwater overflows will be strategically constructed to divert excess water from the existing combined sewer system to the stormwater network during intense rainfall events.

Consequences for the citizen

The infrastructure changes in Lezha will have several impacts on its citizen's house connections. Ensuring separate discharge necessitates the construction of new house connections up to the property line within the area of the new separate sewers. Activities required for the separation of stormwater and sewage entail:

- Implementing a connection for rainwater to stormwater sewers/culverts on streets with stormwater sewers, mandated by statutory regulations.

- Alternatively, rainwater infiltration or direct discharge to the Drini River or Manatia Stream via separate connections, including non-return valves and private house pumping stations for rainwater during flood conditions can be permitted.

- Re-designating existing connections to the combined sewer as wastewater-sewer connections with identifying and rectifying faulty connections of sewerage to the stormwater system.

- Accompanying, supporting, and testing the separation of connections, on the private side of the house connections, with assistance from the UK.

- After completing local construction measures, the remaining tasks of monitoring will be undertaken by the UK.

Residual Flood Risk

The Municipal Infrastructure Programme V has developed several infrastructural adaptations for the water supply and sewer system in Lezha. What impact will these adaptation efforts have on the probability of flooding?

As part of the Municipal Infrastructure Programme V in Lezha, flooding simulations were conducted based on several scenarios. These simulations employed a coordinated approach, factoring in future design flood levels while considering the effects of climate change and sedimentation in the Drini River.

Two variant analyses, accompanied by comprehensive calculations, were undertaken to assess the potential impacts. Additionally, a dimensioning approach was implemented to address the simultaneous occurrence of local heavy rainfall and flooding in the Drini River, which draws upon both empirical data and local knowledge of past flooding events. The following are the **two main load cases that were distinguished**: - The first case (**Load case 1a**), rare rain events (including climate change) with high intensity with simultaneous medium water level in Drini River and Manatia Stream.

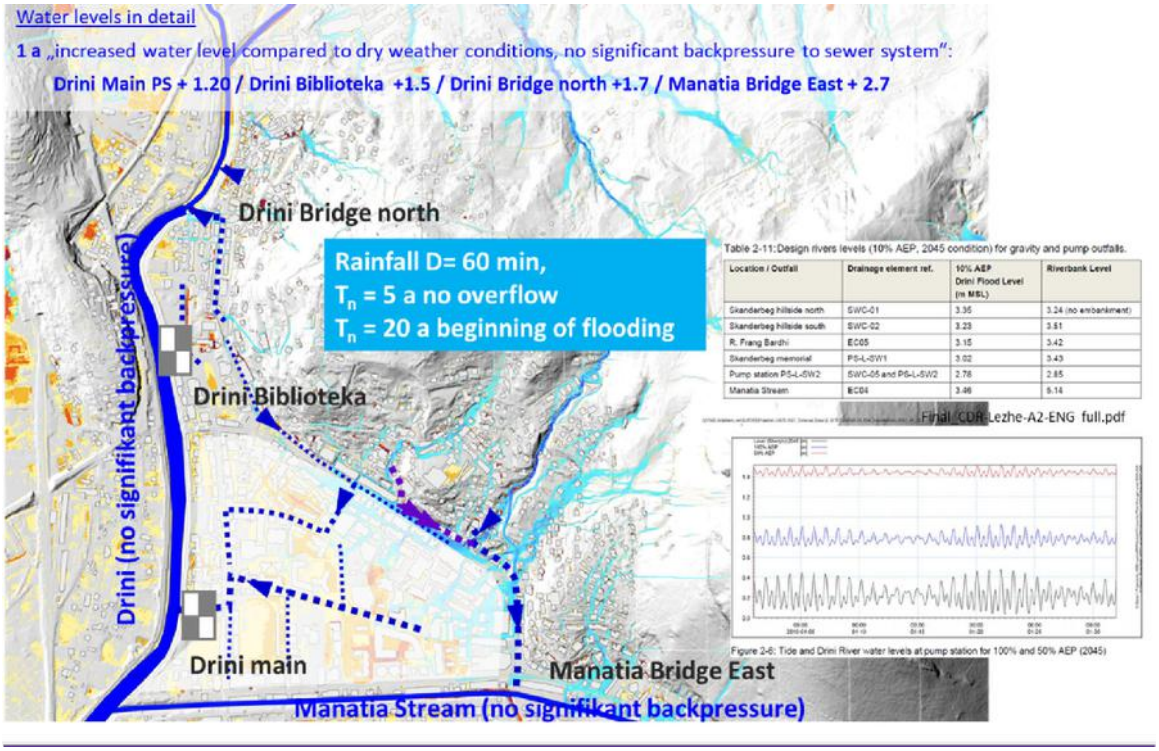


Figure 15; Load case 1a; rain events with high intensity with medium river water level

T = Time, n= recurrence interval in years, a = years

- Tn=5 a = rain event recurring every 5 years
- Tn= 20 a = rain event recurring every 20 years

This means, with significant backpressure (normal water level) of the Manatia river a rain event recurring every 20 years should trigger flooding.

In the second case (**Load Case 2**), the analysis focused on less rare rain events characterized by smaller intensity, occurring during rare flooding conditions. This assessment considered the projected impacts of climate change and the anticipated reinforcement of dikes to accommodate future increases in maximum flood levels.

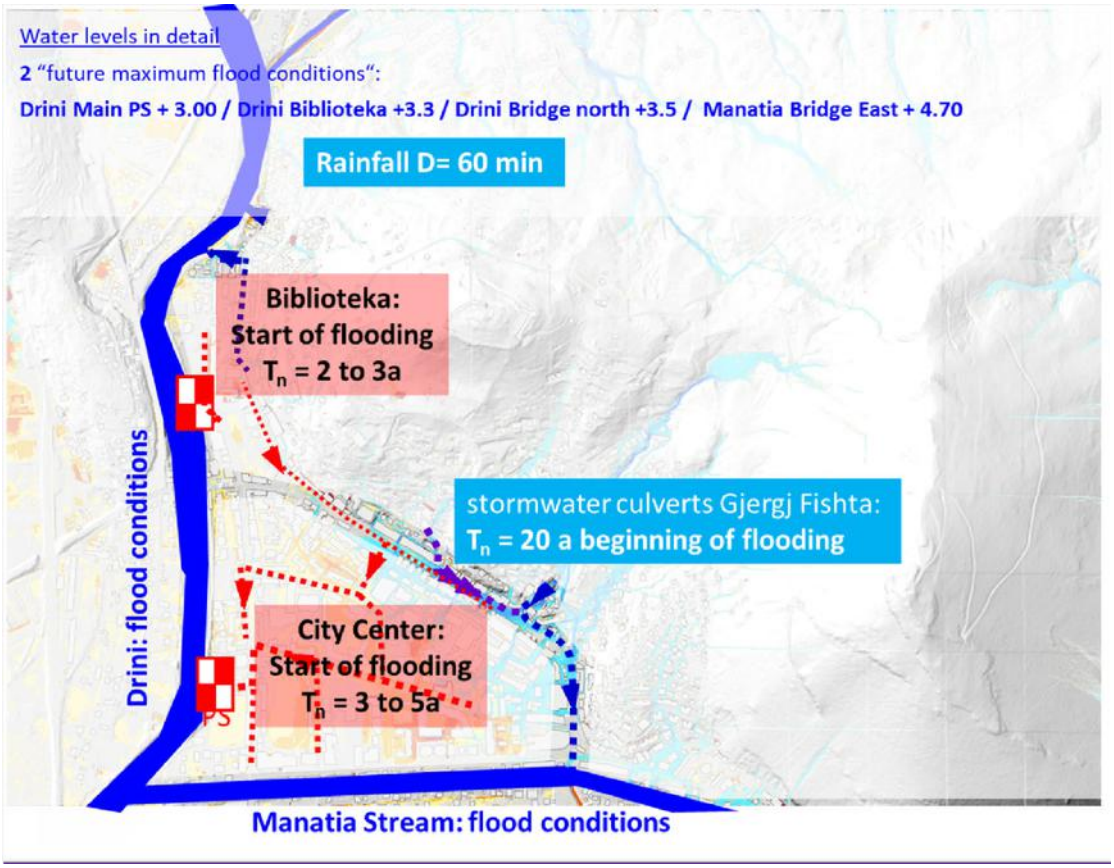


Figure 16; Load case 2a; rain events with small intensity with flooding river water level

This means, with flooding condition of the Manatia river a rain event exceeding recurring every 3 to 5 years should trigger flooding in the centre city of Lezha.

In terms of stormwater pumping station designs, provisions for future expansion of flood protection facilities have already been integrated into freeboard designs.

Based on load case 2 as future design flood, the integration of the pumping stations is mandatory for the future expansion of the flood protection facilities. For this purpose, a minimum freeboard of 0.5 m is provided (in accordance with the German standard DIN 19712 for low dikes). This results in a design level of +3.00m + 0.5 m = +3.50 m A.S.L. for the new PS- L2 stormwater- main pumping station.

This design consideration accounts for the following fundamental factors:

- rare flood event / storm tide
- Climate change
- Sedimentation effects in the future

Given that the catchment area of Lezha City is situated on a watercourse with a substantially larger basin, it is likely that floods in the watercourse and local instances of exceptionally heavy rainfall occur simultaneously only on rare occasion. In case of river flooding, the new stormwater pumping station is required with a capacity of 3m³/s. As already described before, simultaneous flooding of the Drini River and extreme heavy rainfall in the city area is not assumed. The 3 m³/s capacity is sufficient for 3 to 5 ARI events (T_n = 3 to 5 a). Parts of the peak discharge is buffered in the system of the new stormwater culverts and the existing sewers.

In addition to the previously mentioned main load cases, namely one and two, a third load case (LC 1b) is defined as the onset of city flooding originating from the promenade along the Drini River. Although city flooding from the riverside has not been observed since the excavation of the river, this observation is based on a limited period of observation. Therefore, it is imperative to consider potential future sedimentation effects and the impacts of climate change on river hydraulics. Consequently, LC 1b plays a pivotal role in hydraulic investigations and the sizing of stormwater pumping stations.

In LC 1b, the activation of stormwater pumping stations hinges on river water levels. When river water levels rise, the installed penstocks in the stormwater box-culverts are closed, triggering the activation of the pumping stations.

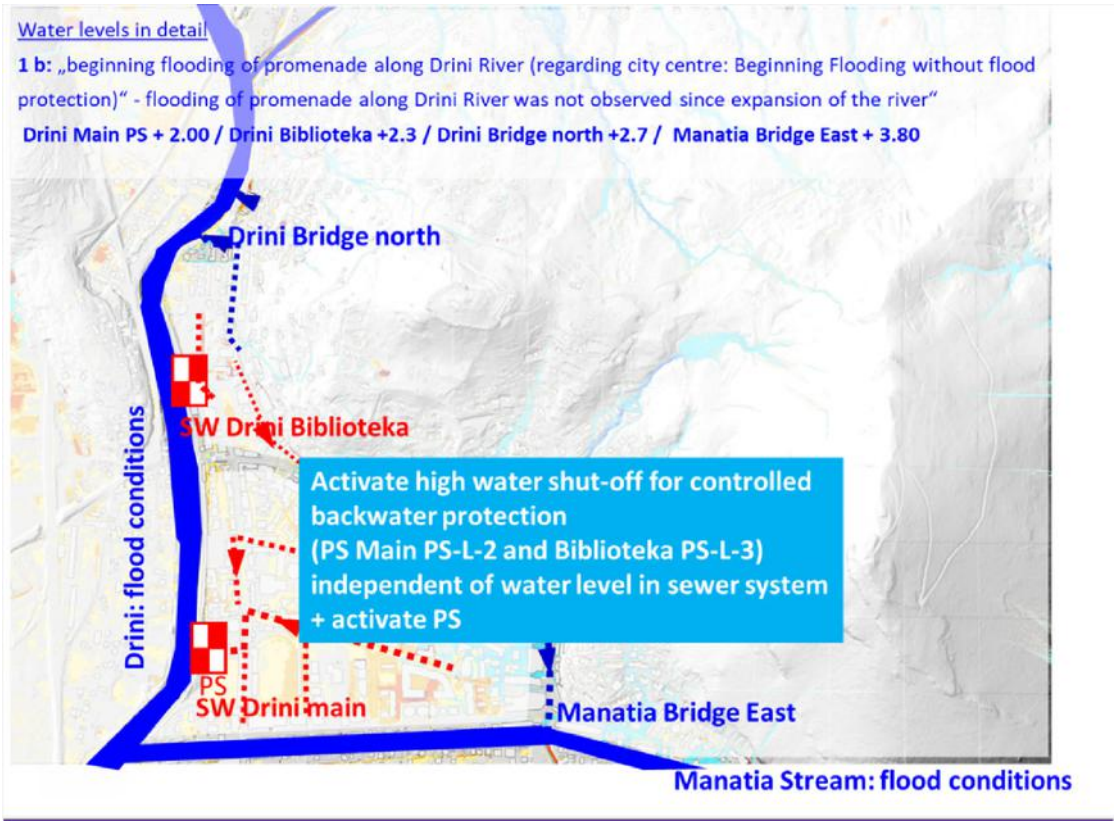


Figure 17: Load case 1b: Activation of storm water pumps related to river water levels

The ultimate and approved design to drain the accruing stormwater from the hillside area of Lezha: see Figure 18.

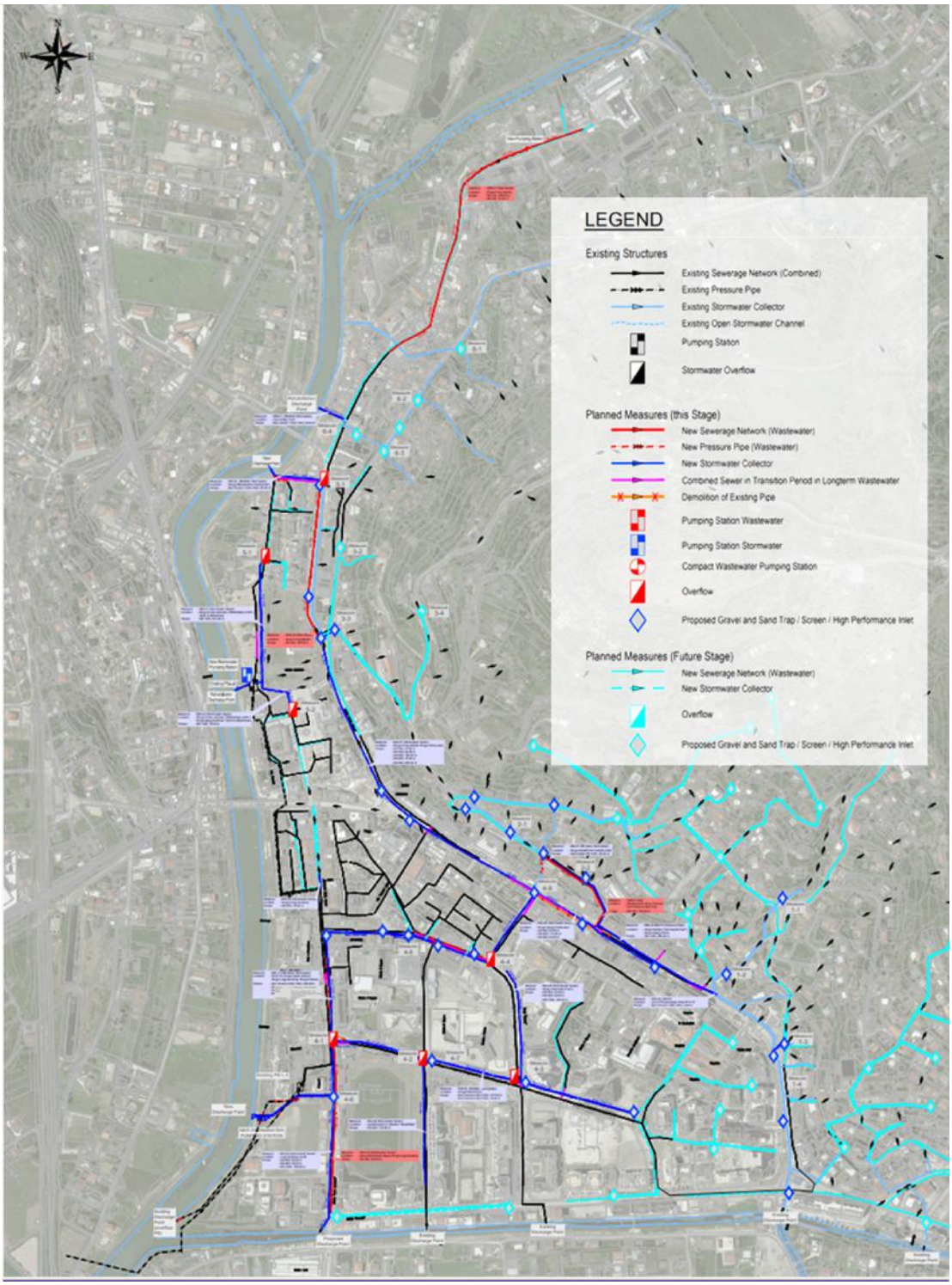


Figure 18: Approved design for draining the accumulating stormwater from the hillside area of Lezha city.

The implementation of the proposed flood protection measures offers relief against a 20% Annual Exceedance Probability (AEP) flood event under current climate conditions. However, scenarios exceeding this threshold will still lead to some degree of flooding, constituting the residual flood risk. This assessment through a Splash Tool Analysis Flooding simulation has been conducted through modelling for varying AEP levels (20%, 10%, and 3%) while factoring in climate change projections up to 2045.

The basis of the modelling is an effective precipitation. Two scenarios were examined for this purpose:

- Effective precipitation = 55 mm / Duration = 60 min
  Depending on the assumed boundary conditions, this is an 33 to 100 ARI [9]- event. Considering climate change (2045 forecast), this is a 33 ARI event (T_n = 33 a).
- Effective precipitation = 30 mm / Duration = 60 min This is approximately a 5 ARI- event (T_n = 5 a).

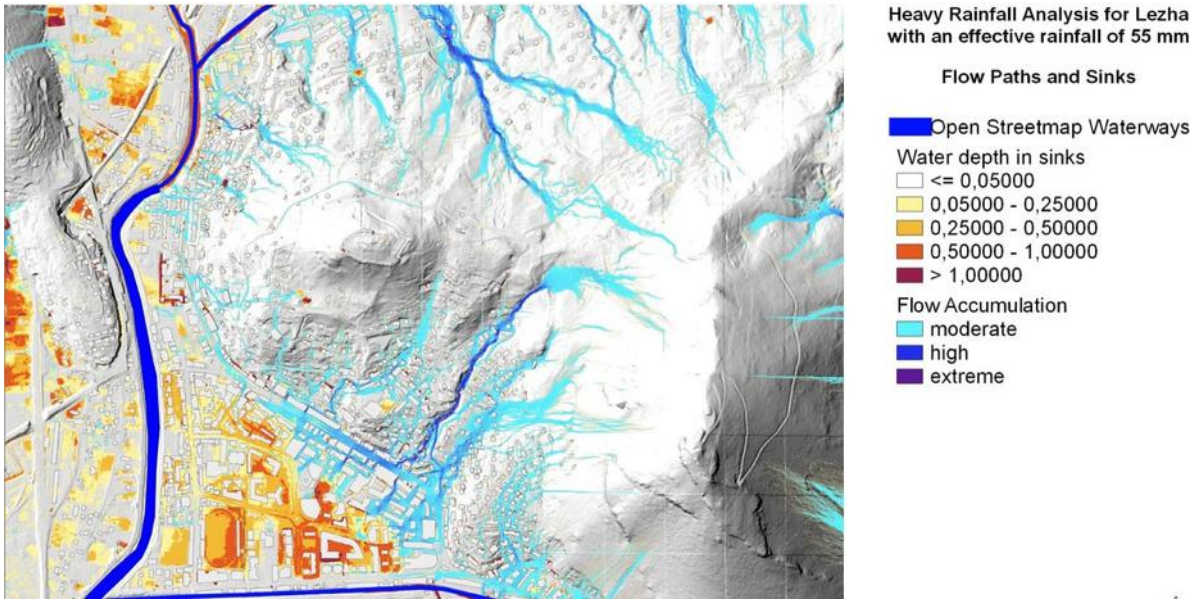


Figure 19: Flooding simulation Surface runoff 55 mm / 60 min

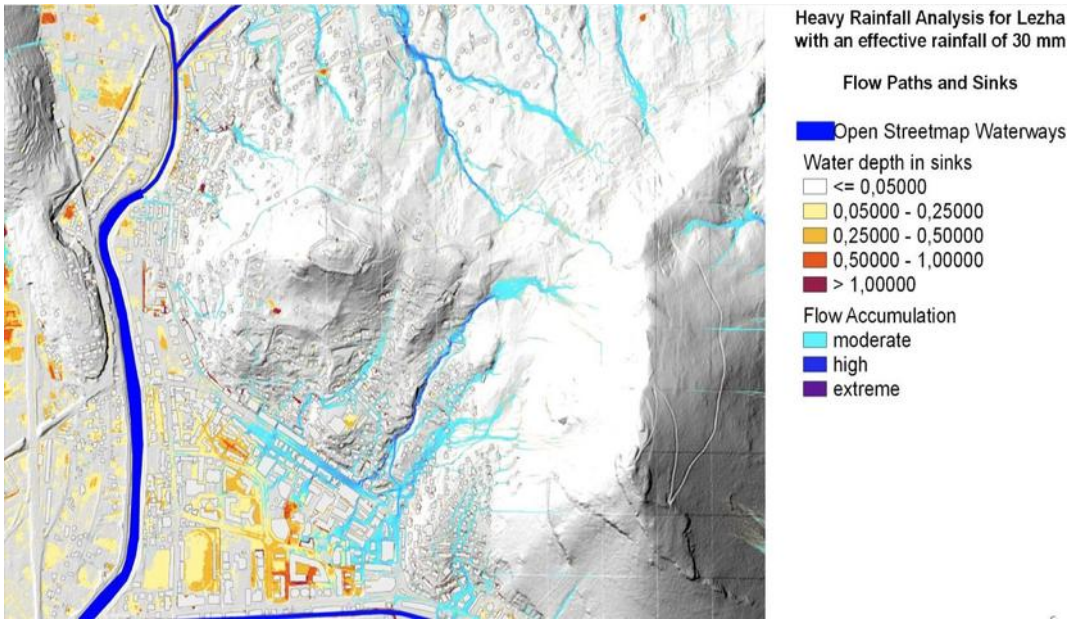


Figure 20: Flooding simulation Surface runoff 30 mm / 60 min

Due to the location of the catchment area of Lezha City on a watercourse with a significantly larger catchment area, it can be assumed that floods in the watercourse and local, exceptionally heavy rainfall only occur very rarely at the same time. Thus, different load cases were provided (see above).

The model scenarios do not incorporate other flood prevention measures, such as reducing impervious areas in the city or implementing small-scale local detention schemes. These additional measures should be regarded as medium-term planning initiatives necessary for sustaining the 20% AEP drainage capacity of the proposed upgrades in response to climate change.

Indeed, the focus of a civil protection plan for Flood Risk Management extends beyond the question of whether flooding will occur or how to prevent it. Instead, it centres on acknowledging the inevitability of future flooding events and focuses on mitigating their impacts and minimizing associated losses.

The following table gives a summary of ffuture Flood Risks in Lezha (2045) after the implementation of the protection measures.

Risk Category	Total in Area	High Risk (20%)	Medium Risk (10%)	Low Risk (3%)
Risk to People				
No. of single residences	97	0	3	4
No. of apartment buildings	158	7	31	43
Approx. no. of people affected*		112	508	704
No of hospitals	1	0	0	0
No. kindergartens / schools	9	0	0	0
No. of other services	11	2	1	2
Risk to Economic Activity				
No. non-residential properties	71	1	3	7
Length of roads (km)	10.76	0.97	2.31	2.77
Nr. electrical switchboards	54	2	3	5
No. of other services	71	1	3	1
Risk to Natural and Historic Environment				
No. of historic monuments	1	1	1	1
No. of churches / mosques	4	0	0	0
Area of parks and gardens (ha)	2.70	0.15	0.30	0.70
No, gas stations.	1	0	0	0

* Based on the assumption of 4 residents per single household and 16 residents per ground floor apartment

Table 6: Summary of residual flood risk to people, economic activities and the environment after the implementation of the flood protection measures, accounting for climate change to 2045.

Hence, the primary objective of civil protection is to develop strategies and measures aimed at reducing the adverse effects and losses that the city will inevitably face when flooding occurs. This proactive approach involves implementing various initiatives such as improving early warning systems, enhancing infrastructure resilience, implementing land-use planning measures, and fostering community preparedness and resilience. By adopting this perspective, the city can better prepare itself to effectively respond to and recover from flooding events, ultimately minimizing the overall impact on residents, businesses, and infrastructure.

4 ALERT SYSTEM

Set up of a strategy on early warning and of creating public awareness

A survey was conducted under the project PRONEWS[1] to understand the knowledge, behavior and awareness capacities of the affected people and others. Some remarkable findings are listed:

- ✓ 85% of the respondents claim to recognize the hazards and vulnerabilities that could affect their community. But as the question related to the recognition of emergency plans, this percentage falls to 32%.
- ✓ Most of them (over 68%) claim to not have any knowledge on the emergency plans and 86% of them do not know what the early warning system (EWS) represents, or which are the communication means of this system at a national or local level.
- ✓ Asked on the roles and responsibilities of government agencies in assessing and reducing risks, only 44% of the respondents think that the General Directorate of Civil Emergencies (GDEC) has a great role in planning and response of emergency situation.
- ✓ From the suggested 11 measures in the questionnaire, the one with the highest percentage is knowing the emergency numbers (112, 129, 126, 128) with 54.6%, following with considering possible hazards before building houses with 43.3%. The lowest percentage or the measure which has been rated as the least important is related to "knowing your local emergency authority, or community plans for evacuation", which has been marked with only 19.7%.
- ✓ Media is the main source of information on learning about risks and early warning systems with 66.5%, followed by schools with 44.5%, while the importance of national or local institutions has marked only 30.1%.

This research underscores the importance of consistently providing information to target groups and administrations to cultivate a broader awareness of natural hazards and risks. An effective awareness strategy should encompass the following specific objectives:

1. Ensuring that affected communities are aware of and familiar with early warning systems.

2. Enhancing the understanding of hazards and risks among affected communities, fostering appropriate behavioral responses.

3. Regularly and comprehensively inform affected communities about relevant developments and updates pertaining to natural hazards and risks.

[1] Program for Improving National Early Warning System and Flood Prevention in Albania. EuropeAid/151248/DD/ACT/AL. 2021

4.1 Albanian early warning system

The Law 45/2019 "On Civil Protection" established the current Albanian Civil Protection structure (see further description in Intervention model). The purpose of Civil Defense is to reduce the risk from disasters and to implement civil defence to guarantee the protection of human life, living things, property, cultural heritage and the environment, through the strengthening of the Civil Defence system, by defining the responsibilities of institutions and structures of this system, international cooperation, rights and obligations of citizens and private entities, education, training and inspection[2].

The same law declares further that "*An integrated system of communication and early warning or civil emergencies will be introduced as a unified 112 Operational Centre. Moreover, the new Civil Protection structure will adopt a multi-level system, emphasizing the role of local levels, whose competencies and responsibilities will be enhanced and enlarged to include preventative activities and planning, under the responsibility of prefects*".

General aspect: An effective early warning[3] system must be:

1. Multi-Hazard: they are designed to detect different hazards that may occur alone, simultaneously, or in cascade.
2. End-to-end: the system covers the entire range, from hazard detection to action, which includes providing understandable and actionable warning messages.
3. People-centered: this means designing the systems with people in mind, to empower them to act on time and in an appropriate manner to reduce potential harm.

Typically, the most severe impacts of natural hazards affect economically disadvantaged or marginalized segments of the population, who often have limited agency to protect themselves. For instance, land prone to flooding is usually more affordable than safer alternatives, leading those with fewer resources to settle in flood-prone areas. In such circumstances, it often falls upon governments, with support from civil society organizations, to assume a leadership role, making decisions and taking actions on behalf of the affected population. However, relying solely on a top-down approach is suboptimal as it diminishes the decision-making autonomy of the marginalized individuals.

The best early warning systems bring 'bottom-up' and 'top-down' approaches together - where a mixture of local, national, and international frameworks can be integrated in a community-focused, co-produced system, better outcomes are achieved.

Driving good practices for impact-based warnings

[2] https://akmc.gov.al/en/about-akmc/
[3] https://www.undrr.org/early-warnings-for-all

1. *Relationships and collaboration*

At the local level, establishing effective early warning system relationships typically involves multiple layers of government, numerous stakeholder groups, and key agencies. These may include a hydrometeorological agency, a geophysical agency, and a civil defense agency, among others, leading to various arrangements and complexities.

This entails regular communication, genuine listening, and a willingness to adapt to evolving community needs, even amidst changes in personnel within associated organizations. Neglecting to prioritize the creation and sustenance of these relationships can hinder efforts to improve early warning systems. Conversely, when strong relationships are cultivated, achieving progress in early warning systems becomes both feasible and attainable.

2. *Community empowerment*

Any effective warning system should strive to be inclusive of, and ideally co-owned by, the communities which it serves. In certain scenarios, the initial warning may originate from within the community itself and subsequently be disseminated to other potentially affected populations. Establishing strong "first mile" relationships are crucial for an inclusive and empowering early warning system and should be a priority long before any crisis emerges. In cases where such relationships are lacking, efforts should be directed towards prioritizing training and conducting simulations to bridge this gap. Civil society organizations skilled at advocating for user-centered, relationship and culturally diverse approaches have a large role to play in this context.

3. *Risk knowledge measures – working to refine risk information.*

The community might rightfully assume that emergency managers of the civil protection unit have all of the information that they need to keep the population safe. This is never the case. Often, simple physical factors are not well-enough known. At all levels, it is critical that the gaps in risk knowledge are closed, and preferably under an ongoing, stable program that continuously improves the information.

4. *Monitoring and warning; Obtaining and integrating data is vital for effective warnings.*

Significant strides in science and technology have paved the way for anticipatory actions to be taken with greater confidence and earlier than ever before. However, the integration of these advancements into operational systems falls short of its potential. Despite the highly organized nature of hydrometeorology, substantial gaps persist in observation networks and data sharing.

Non-governmental agencies play a crucial role in addressing these shortcomings by advocating for the community's need for accurate warnings and by promoting transparency across all levels of the warning process, from international to local. Their efforts contribute to ensuring that the benefits of advancements in science and technology are accessible and impactful for everyone.

5. *Improved preparedness and response capabilities; the importance of testing warnings via exercises*

The escalation of rapidly evolving and complex warning scenarios, such as floods, can swiftly transition into disasters if communities are not adequately prepared and organized well in advance. Effective actions cannot be prompted at the last minute; they require long-term preparedness measures, which encompass comprehensive plans and standard operating procedures. These measures should incorporate regular exercises that extend down to the community level.

6. *Enhanced communication; Impact-based forecasts and warnings.*

The adoption of impact-based forecasts and warnings signifies a fundamental shift in perspective. An impact-based warning changes the emphasis in the warning from 'what the hazard(s) will be' to 'what the hazard(s) will do'[4].

Impact-based warnings prioritize understanding the potential consequences of hazards. This shift offers substantial benefits by enhancing user comprehension of risks and impacts.

Alerting procedures are a fundamental part of Early Warning System and the Civil Protection system is gradually activated based on **Status Indicators (SI)**, derived from the automated monitoring network or from assessment teams that monitor areas at risk, and from **Context Indicators (CI)** which are derived from forecasts and hydrometeorological bulletins.

This civil protection plan presents a draft outline of alerting system which however needs still to be fully detailed by the civil emergencies services of Lezha, precisely defining all its components.

Experience has demonstrated that an effective Early Warning System (EWS) hinges on four key elements:

1. **Detection, Monitoring, and Forecasting of Hazards**: This involves the continuous surveillance, monitoring, and forecasting of potential hazards such as floods, storms, fires, and other natural events to identify emerging risks.
2. **Risk Analysis**: Conducting comprehensive risk assessments to evaluate the potential impact, severity, and likelihood of hazards, enabling informed decision-making and targeted interventions.
3. **Timely Dissemination of Warnings**: Ensuring the swift and authoritative dissemination of timely warnings to the public, businesses, and authorities, backed by government endorsement to convey urgency and credibility.

[4] Guidelines on Multi-hazard Impact-based Forecast and Warning Services have been published by the World Meteorological Organization, with an emphasis on the hydrometeorological perspective. See https://public.wmo.int/en/media/news/impact-based-forecasting-informs-anticipatory-action

4. **Activation of Emergency Plans**: Promptly activating emergency response plans at various levels of government and organizations to prepare for and respond effectively to anticipated hazards.

These four components must be seamlessly coordinated across multiple agencies at national, regional, and local levels to function as an integrated system. By engaging individuals, communities, governments, businesses, and other stakeholders, this system facilitates proactive action to mitigate disaster risks before hazardous events occur.

4.2 Real-time monitoring activities; Detection, Monitoring, and Forecasting of Hazards

As for forecasts, monitoring activities constitute a fundamental part of the activation of the prefectural Civil Protection system.

Monitoring procedures can be both automated or analogic/human driven. Monitoring activities provide another set of indicators (Status indicators) which injects into the prefectural standard operative procedures allowing the gradual activation of its Civil Protection system.

Monitoring and dissemination of Daily Bulletin on Natural Hazards from - IGEO - The National Center for Forecast and Monitoring of Natural Hazards (NCFMNH)[5].

The National Center for Forecasting and Monitoring of Natural Hazards (NCFMNH), a division of the Institute of Geosciences (IGEO), is dedicated to executing operational tasks related to monitoring, analyzing, and forecasting hydro-meteorological phenomena and forest fires across the country. Its primary objectives include timely informing both authorities and the public about impending hydro-meteorological events and forest fires, as well as archiving and documenting extreme events. Additionally, the center provides support for research activities conducted by the Department of Hydrology and Meteorology.

Status Indicators

Status Indicators (SI) are derived by the real-time or near-to-real time observations of the event and of its impacts on the territory as it unfolds. This is done mainly through:

- National Weather Stations network & NCFMNH
- Communication of assessment teams deployed on the field (UK Lezha, Albanian Red Cross, agriculture irrigation board,)
- Communication from other institutional stakeholders (I.e. neighboring municipalities, Prefecture, irrigation boards, General Directorate of Civil Emergencies, etc.)
- Population through institutionalized communication channels (emergency numbers)

The forecasts provided by the NCFMNH are categorized into four risk levels: Green, Yellow, Orange, and Red, with rainfall intensity serving as the basis for classification. These forecasts cover a time span of "today and tomorrow" and are limited to a maximum of 36 hours (refer to the annex), meaning that the preparation window is less than 36 hours.

Daily Notification

In the framework of forecasting the expected extreme hydro-meteorological events, a daily bulletin "Bulletin of Natural Hazards" is compiled in NCFMNH. The bulletin is distributed to its recipients via

[5] https://www.geo.edu.al/Natural_Hazards/Hydrological_Meteorological_Hazard/

email no later than 12:00 am and announces the expected danger related to climatic phenomena (rainfall, temperatures, wind, etc.), floods and forest fires.

The forecast published in this bulletin extends over a time range of 36 hours starting from the moment of its distribution (12:00 am) for the current day until 24:00 of the next day.

The Bulletin of Natural Hazards shows in tabular form and through the map:

1. Meteorological hazard, which includes information on expected rainfall
2. Hydrological hazard which alerts about Flash Floods, Fluvial Floods
3. Landslides
4. Hazard from Forest Fires

Context indicators:

Context Indicators (CI) are constituted mainly by the indications given by the bulletin produced daily by IGEWE, providing the evaluation of the hydrometeorological risk. Keeping in mind that the thresholds provided are only pluviometry and that further studies need to be are necessary to evaluate corresponding criticalities, 4 levels are foreseen in the following scheme:

If no significant phenomena are forecasted, a Null Criticality (Green) is issued. Otherwise if conditions reach critical level, the following 4 levels are issued:

0) Green (null criticality)
1) Yellow
2) Orange
3) Red

The forecasts provided by the NCFMNH are categorized into four risk levels: Green, Yellow, Orange, and Red, with rainfall intensity serving as the basis for classification. These forecasts cover a time span of "today and tomorrow" and are limited to a maximum of 36 hours (refer to the annex), meaning that the preparation window is less than 36 hours.

Actual Daily IGEWE's bulletin on Natural Hazards, included in the pluviometry alert thresholds.

BULETINI MBI RREZIQET NATYRORE *(Bulletin on Natural Hazards)*
Qendra Kombëtare për Parashikimin dhe Monitorimin e Rreziqeve Natyrore
Facebook page : Instituti i Gjeoshkencave, Webpage: www.geo.edu.al

Buletini Nr. 18/ 2024, 18-01-2024	**Parashikimi** nga 18-01-2024, ora 12:00 deri 19-01-2024, ora 23:59.

PARASHIKIMI I RREZIKUT NGA PËRMBYTJET

Sot pasdite (e enjte, dt.18) dhe gjatë pjesës së parë të ditës së nesërme (e premte, dt.19) do të ketë reshje me intensitet të lartë kryesisht në veri dhe qendër të vendit. Në qarkun e Shkodrës mund të ketë vërshime të shpejta të lumenjve të vegjël malorë dhe rrëshqitje të dherave. Në zonat urbane, në këtë qark mund të shfaqen probleme me përmbytje të lokalizuara, në varësi të gjendjes së kanalizimeve.

PARASHIKIMI METEO

RESHJET
Sot pasdite (e enjte, dt.18) dhe nesër (e premte, dt.19) priten reshje intensive deri lokalisht shumë intensive në qarkun Shkodër. Në qarqet Dibër, Lezhë, Durrës, Tiranë, Elbasan, Vlorë dhe Gjirokastër priten reshje mesatare deri lokalisht intensive, ndërsa në qarqet e tjerë priten reshje të dobëta deri lokalisht mesatare. Në shumicën e qarqeve reshjet do të shoqërohen me shtrëngata (siç tregohet në tabelë, respektivisht për secilin qark).

TEMPERATURA

Nesër (e premte, dt.19) temperaturat minimale dhe maksimale të ajrit pritet të arrijnë:

në bregdet: 12 / 17 °C

në vendet e ulëta: 10 / 16 °C

në vendet malore: 5 / 11 °C

ERA
Sot pasdite (e enjte, dt.18) dhe nesër (e premte, dt.19) era pritet të fryjë mesatare deri e fortë, kryesisht në bregdet.

NIVELET E RREZIKUT	**S'KA RREZIK**	**I ULËT**	**I MODERUAR**	**I LARTË**

igeo	Instituti i Gjeoshkencave – IGJEO	
Operator: Gazmir Çela	*Koordinator: Elona Abazi (Tel: +355 69 311 9392, e-mail: albania.hazards@gmail.com)*	*faqe 1 / 3*

BULETINI MBI RREZIQET NATYRORE *(Bulletin on Natural Hazards)*
Qendra Kombëtare për Parashikimin dhe Monitorimin e Rreziqeve Natyrore
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Buletini Nr. 18/ 2024, 18-01-2024	**Parashikimi** nga 18-01-2024, ora 12:00 deri 19-01-2024, ora 23:59.

PARASHIKIMI I DETAJUAR MBI RREZIQET NATYRORE (SOT DHE NESËR)

RREZIKU MAKSIMAL I QARKUT	*Zjarre në pyje*	*Ngjarje Meteorologjike*			*Ngjarje Hidrologjike*		
	Zjarret Mesatarja e qarkut	*Reshje 24-orëshe Mesatarja e qarkut*	*Reshje 24-orëshe Maksimale të lokalizuara*	*Shtrëngata*	*Përmbytje të Shpejta*	*Përmbytje Lumenjsh*	*Rrëshqitje toke*
SHKODËR	S'KA RREZIK	intensive	shumë intensive				
KUKËS	S'KA RREZIK	mesatare					
DIBËR	S'KA RREZIK	mesatare	intensive				
LEZHË	S'KA RREZIK	mesatare	intensive				
DURRËS	S'KA RREZIK	mesatare	intensive				
TIRANË	S'KA RREZIK	mesatare	intensive				
ELBASAN	S'KA RREZIK	mesatare	intensive				
FIER	S'KA RREZIK	të dobëta					
BERAT	S'KA RREZIK	të dobëta	mesatare				
KORÇË	S'KA RREZIK	të dobëta	mesatare				
VLORË	S'KA RREZIK	mesatare	intensive				
GJIROKASTËR	S'KA RREZIK	mesatare	intensive				

Instituti i Gjeoshkencave – IGJEO		
Operator: Gazmir Çela	*Koordinator: Elona Abazi (Tel: +355 69 311 9392, e-mail: albania.hazards@gmail.com)*	*faqe 2 / 3*

BULETINI MBI RREZIQET NATYRORE *(Bulletin on Natural Hazards)*
Qendra Kombëtare për Parashikimin dhe Monitorimin e Rreziqeve Natyrore
Facebook page : Instituti i Gjeoshkencave, Webpage: www.geo.edu.al

Buletini Nr. 18/ 2024, 18-01-2024	**Parashikimi** nga 18-01-2024, ora 12:00 deri 19-01-2024, ora 23:59.

LEGJENDA: ***Reshjet 24-orëshe***

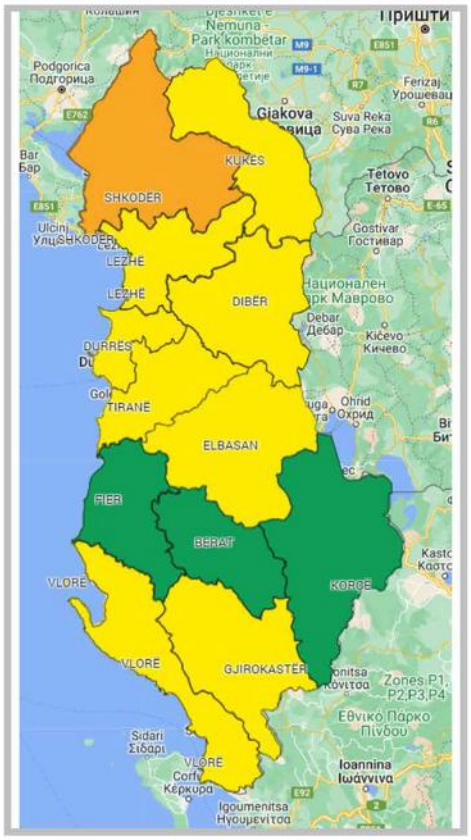
Niveli i Rrezikut	***Reshje shiu*** (mm / 24 orë)
S'KA RREZIK	të dobëta (0 – 15 mm / 24 orë) Nuk priten fenomene hidro-meteorologjike problematike.
I ULËT	mesatare (15 – 45 mm / 24 orë) Mundësi që të shfaqen fenomene hidro-meteorologjike problematike.
I MODERUAR	intensive (45 – 90 mm / 24 orë) Moti parashikohet i rrezikshëm. Parashikohen fenomene të pazakonta hidro-meteorologjike.
I LARTË	shumë intensive (> 90 mm / 24 orë) Moti është shumë i rrezikshëm. Parashikohen fenomene të pazakonshme hidro-meteorologjike mjaft intensive.

LEGJENDA: ***Zjarre në pyje***

S'KA RREZIK	Zjarret e mundshëm janë të kontrollueshëm lehtësisht.
ULËT	Barërat e thatë dhe pyjet mund të digjen lehtë. Flakët janë te mesme në pyje dhe të shpejta në zonat e ekspozuara.
I MODERUAR	Ndezja e zjarreve mund të ndodhë lehtë dhe me përhapje të shpejtë. Zjarret mund të jenë shumë të nxehtë, me kurora përhapje të vogla dhe të mesme.
I LARTË	Ndezja mund të shkaktohet edhe nga një shkëndijë. Zjarret janë shumë të nxehtë me përhapje shumë të shpejtë të flakëve si rrjedhim kontrolli i tyre është shumë i vështirë.

SIMBOLE

	Shtrëngata: reshje mbi 20 mm/3orë. Moti mund të krijojë probleme të ndryshme
	Përmbytje urbane ose nga përrenjtë dhe lumenjtë e vegjël
	Përmbytje nga lumenjtë e mesëm dhe të mëdhenj
	Rrëshqitje toke



RREZIKU MAKSIMAL I QARKUT
për sot dhe nesër, dt. 18 – 19.

Notification in Cases when High Risk is expected.

When a high level of a natural hazard is anticipated, the bulletin produced by IGEWEis issued two or three times a day, contingent upon the severity of the expected event.

For high-risk events such as floods, fires, high temperatures, frost and snow, storms, and strong winds, a comprehensive report is compiled. This report provides detailed information on the risk level, potential magnitude, anticipated impact, expected timing, and probable duration of the event. It is meticulously crafted by the expertise of responsible academic staff.

Following the approval from the Directorate of IGJEO and the Heads of the DH and DM Departments, this detailed report is forwarded to the National Agency of Civil Protection (NACP). Depending on the urgency of the situation, the report may also be simultaneously transmitted to the NACP. The director of IGJEO holds the authority to convene the IGJEO Emergency Headquarters when deemed necessary based on the anticipated situation.

4.2.1 Problems encountered with real time monitoring activities in Lezha.

In 2024, Lezha experienced severe flooding incidents in both January and March. Press releases from these months documented extensive flooding and accompanying power outages. The inundation of roads and sidewalks, with water levels reaching up to 30 cm, resulted in the obstruction of building entrances. Additionally, adverse weather conditions led to electricity supply disruptions, plunging most villages into darkness during the night.

See press release:

- https://www.cna.al/english/aktualitet/permbytje-ne-Lezha-nga-moti-i-keq-nderprerje-te-energjise-elektrike-i392012
- https://euronews.al/en/floods-in-lezha-pjerin-ndreu-5-families-have-been-evacuated-several-houses-are-underwater/

Despite these occurrences, the bulletins issued by the National Center for Forecasting and Monitoring of Natural Hazards (NCFMNH) did not indicate any risk of flooding in Lezha. In line with this absence of alerts from official channels, it is logical that emergency services in the city and prefectures refrained from issuing warnings to the population.

The bulletin of March 18th is mentioning: YELLOW *medium (15 – 45 mm / 24 hours); Possibility of problematic hydro-meteorological phenomena.*

The bulletin of March 19th in mentioning: ORANGE *intensive (45 – 90 mm / 24 hours) The weather is forecast to be hazardous. Unusual hydro-meteorological phenomena are predicted.*

Nevertheless, recognizing the importance of proactive measures in safeguarding against natural disasters, the Ministry of Defence issued a general advisory urging municipalities to take necessary steps to warn residents, particularly in areas with heightened susceptibility to such events.

- https://euronews.al/en/deteriorating-weather-peleshi-calls-on-municipalities-take-measures-against-flooding/

General problem: The conclusion is that the forecasts issued by the National Center for Forecasting and Monitoring of Natural Hazards (NCFMNH) lack both accuracy and timeliness. This deficiency significantly impedes the ability of emergency services to proactively implement preventive measures against flooding and other natural hazards.

Consequently, it remains unclear when to classify a situation as high risk, as the threshold for such determination is not firmly established. This lack of clarity extends to the provision of detailed information regarding risk levels, potential magnitude, anticipated impact, expected timing, and probable event duration, as outlined in the protocol concerning "high risk." Additionally, it is uncertain whether this comprehensive report is transmitted to the National Agency of Civil Protection (NACP). As a result, the threshold to initiate the entire process remains unstable and undefined.

Several points for improvement of the real-time monitoring in Lezha can be identified.

1. Firstly, the accuracy of the NCFMNH hazard bulletins. The forecasts furnished by the NCFMNH rely on data from the meteorological station of Lezha (location, see Figure 23), which is a manual station. Data from manual stations are recorded in a traditional manner, requiring the presence of an observer. These records are then centralized and processed by the NCFMNH to generate hazard bulletins. However, this process is time-consuming and may not provide actionable data for risk prevention in a timely manner.

Figure 21: Manual meteorological station.

Figure 22: Location of manual meteorological station of Lezha.

2. Make natural hazard bulletins available 365/365. An analysis of the available hazard bulletins on the NCFMNH website[6] reveals that no observation and hazard bulletins are generated on Sunday. This implies that approximately 14% of timely observations are unavailable, diminishing the reliability and completeness of the information provided.
3. Regarding the Hydrology Monitoring Network, Albania's hydrological monitoring infrastructure comprises both manual and automatic stations. Data from the manual monitoring stations are collected twice daily by observers at 7:00 and 19:00. These observations are recorded in a logbook by the observer, and the information is then mailed

6 https://www.geo.edu.al/MonitoringForecast/Hydrologic_Meteorological_Forecast/Bulletin_on_Natural_Hazards/

to the Institute of Geosciences (IGEO). In Lezha, a manual gauge is employed to monitor the water level of the Drin River (Figure 25). Situated in the city centre beneath the main bridge. This gauge plays a crucial role in monitoring river levels and informing flood risk assessments and management efforts. Due to the manual monitoring, reporting of river levels is time consuming.

4.

Figure 23: Obstruction of intake points

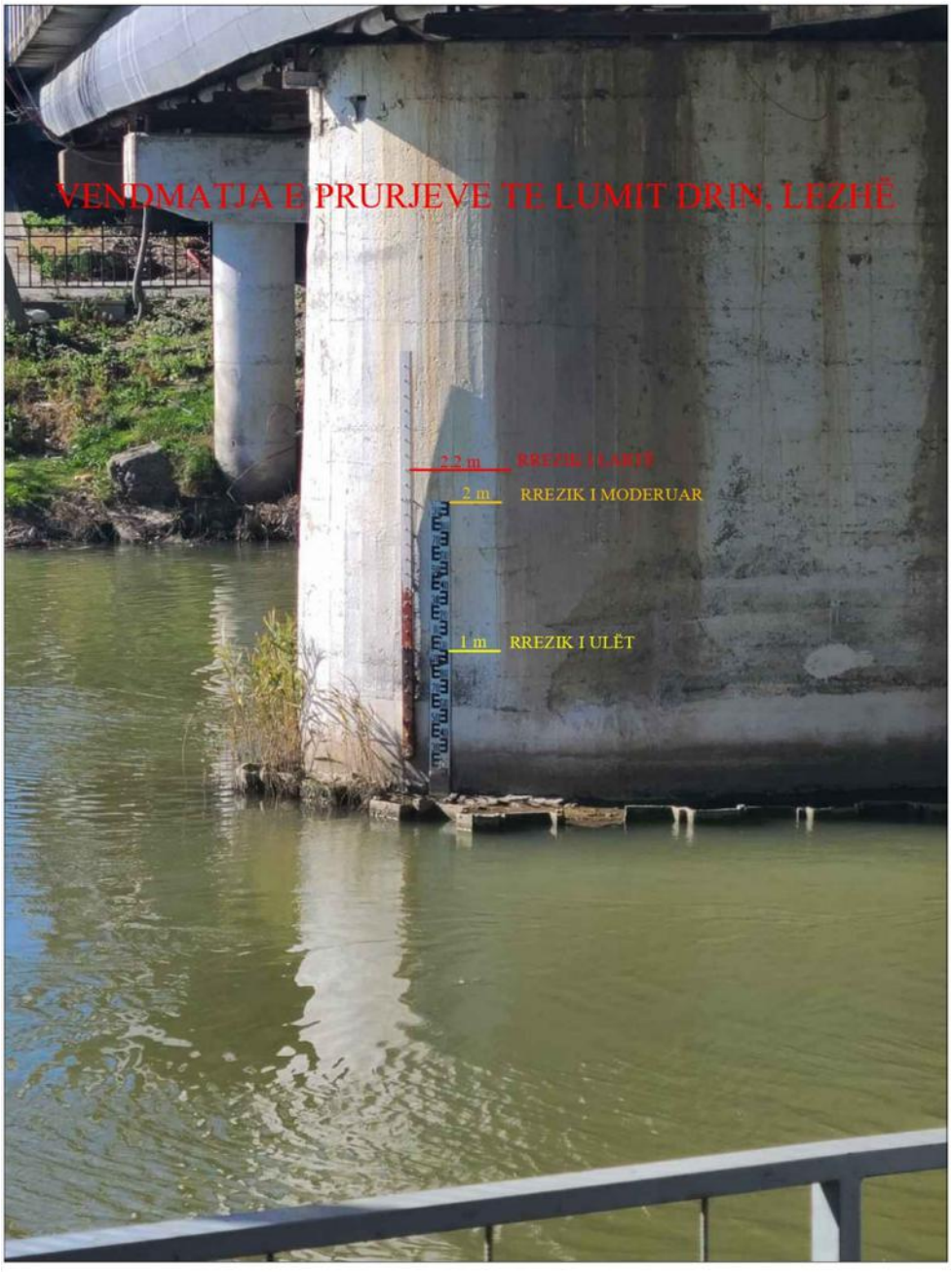


Figure 24: Gauge for water level monitoring on Drin River in Lezha.

Infrastructural improvements for real-time monitoring in Lezha include:

1. Installation of an Automatic Thermometric and Pluviometry Meteorological Station: Introducing automatic meteorological stations in Lezha offers several advantages. These stations conduct frequent meteorological measurements at regular intervals, providing valuable data for forecasting and monitoring purposes. Additionally, they archive measured data or broadcast it in real-time through various computer programs. By optimizing meteorological observations using automatic stations, Lezha can enhance its early warning system's capabilities and better address the region's social and economic needs through more in-depth scientific research.

Figure 25: Automated meteorological station in Shkodra

2. Accurate monitoring of the river level is an important prerequisite to be able to react quickly and correctly in the event of a flood. Data recording and transmission via radio link is the optimal solution for getting level information on rivers in remote areas without power. These automatic stations transmit crucial data every 2 hours and boast remote configurability. Parameters monitored by the hydrological network encompass water level, water temperature, and sediment concentration. Given Lezha's susceptibility to flooding, the installation of equipment to monitor the water level of the Drin River is deemed indispensable.

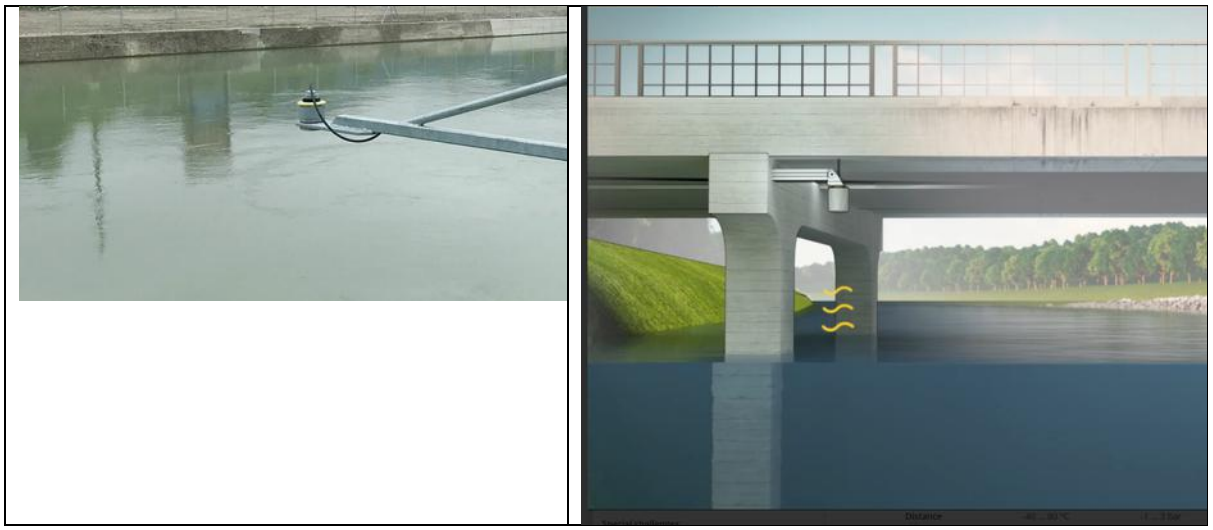


Figure 26: River level measurement by radar sensor measurement

The current automatic station network in Albania comprises 25 stations, with 20 stations strategically positioned across the country through investment from the World Bank. Additionally, 5 stations are situated in the Drin Buna Basin, financed by the German Government through GIZ.

3. Integration of meteorological forecasts with real time local rainfall and river level data is proposed to be included in the new Besalidhja storm water pump station with SCADA system. This will make monitoring data accessible via web and smartphone apps 7/7 and 24/24h. This real time monitoring equipment should be provided to UK Lezha as part of the Besalidhja pump station. This may entail upgrading to automated monitoring stations capable of providing real-time data, implementing more efficient data processing methods, and ensuring round-the-clock availability of hazard bulletins to enable timely and informed decision-making by emergency services and the wider community.

4. Engaging the local community of the centre of Lezha in stormwater monitoring can be an effective strategy to prevent intake points from becoming blocked due to sand and debris accumulation. Here are some ways to involve the local community:

- Awareness Campaigns: Launch educational campaigns to raise awareness among residents about the importance of maintaining stormwater intake points. Inform them about the consequences of blockages, such as increased flooding risks and property damage.
- Adopt-a-Drain Programs: Establish an adopt-a-drain program where residents can volunteer to adopt specific stormwater drains or intake points in their neighbourhood. They commit to keeping the area around the drain clear of debris and report any issues to the local authorities.
- Citizen Reporting Platforms: Set up a citizen reporting platform where residents can easily report blocked intake points or other stormwater-related issues. This could be through a mobile app, website, or hotline.

- Training and Education: Provide training sessions and workshops to community members on how to properly maintain stormwater intake points, including identifying signs of blockages and safely clearing debris.

4.2.2 Monitoring procedures

Improving Contextual Indicators: Up to this point, the contextual indicators have been primarily based on precipitation and temperature monitoring alone. However, with the installation of multifaceted monitoring equipment in Lezha, a wider array of information can be gathered to establish more comprehensive contextual indicators. This expanded dataset may include various types of data to assess the impacts of events, resulting in a more thorough scheme. As a result, this will enable a more precise evaluation of flood risks and enhance the procedures to be enacted before and during such events.

STATE INDICATOR (SI)		**INFORMATIONS FROM MONITORING NETWORK OR ASSESSMENT TEAMS DEPLOYED ON THE GROUND**	**CRITICALITY** (C)
SI1	$SI1_1$	RAINFALL intensity up to moderate (45 – 90 mm / 24 hours), no thunderstorms, non-stationary (for threshold values see hazard bulletin)	Low criticality
	$SI1_2$	ON roads: isolated puddles	
		River beds: base flow discharge	
		Water level: 1/3 of the critical section on Lezha bridge	
		LANDSLIDE: modest presence of runoff waters	
SI2	$SI1_2$	RAINFALL of high intensity (45 – 90 mm / 24 hours)	Medium Criticality
	$SI2_2$	Hydrometric levels: rising, reaching the alert threshold	
	$SI2_3$	ON ROADS: runoff waters reaching the tires, ankles of pedestrians, water very turbid	
		Storm drains obstructed	
		IN RIVER BED: raising discharge	
		Water level: 1,5 m or 2/3 of the critical section on Lezha bridge gauge	
		LANDSLIDES: runoff waters and erosion signs	

SI3	$SI3_1$	RAINFALL of very high intensity (> 90 mm / 24 hours), persistent and autoregenerant	
	$SI3_2$	HYDROMETRIC LEVELS: quickly raising, reaching bankfull levels	
	$SI3_3$	ON ROADS: water at the height of the car body, difficulty walking buoyancy of heavy materials	
		IN RIVERS: bankfull discharge	
		Water level: critical level of 2,2m on Lezha bridge gauge (see fig 24)	
		LANDSLIDES: land movements, roads obstructed	

Table 7: Synopsis of State Indicators and correlated criticality level

4.2.3 Monitoring data Exchange

- The Directorate of Civil Emergencies, headquartered in the Prefecture of Lezha, is tasked with overseeing the execution of strategies, policies, and plans for Civil Emergency programs, activities, and processes. This body maintains direct communication with the Albanian Civil Protection structure, ensuring seamless coordination. Consequently, all data collected from the monitoring equipment should be accessible and comprehensible within this entity.
- Additionally, the Directorate of Civil Emergencies holds the authority to **disseminate warning communications** as part of its mandate.
- This entity is further designated as the responsible entity for managing data exchange within the prefecture and take responsibility of listing the existing sources of reliable and official information: This includes comprehensive documentation detailing all established sources of dependable and officially sanctioned information pertinent to civil emergencies. These sources may encompass governmental agencies, meteorological services, environmental monitoring stations, disaster response organizations, and other relevant entities recognized for their credibility and authority in providing essential data for emergency management.

- Communication with municipal authorities, the Commission of Civil Emergencies, UK Lezha, the Albanian Red Cross, and neighborhood committees is a crucial aspect of the center's operations. This ensures that timely information and alerts are relayed to key stakeholders responsible for managing emergency response efforts. The monitoring and analysis activity of hydro-meteorological events is based on:

    - Monitoring of hydrological and meteorological data recorded in real-time by automatic stations.
    - Utilization of mathematical models (meteorological and hydrological) available in IGEO to analyze the necessary parameters.

- Adoption of internationally certified models for forecasting weather, floods, and forest fires. These models include the European Centre for Medium-Range Weather Forecasts (ECMWF), ICOsahedral Nonhydrostatic (ICON), Global Forecast System (GFS), Flash Flood Guidance System with Global Coverage (FFGS), European Flood Awareness System (EFAS), European Forest Fire Information System (EFFIS), among others, to analyze the necessary parameters.

Event Documentation and data archiving

In instances of flooding and other hazards like fires, frost and snow, storms or strong winds comprehensive documentation and archiving take place. The documentation process encompasses all gathered information pertaining to each specific event, sourced from various channels including:

1. Field observers: Reports and observations provided by personnel deployed in the field to monitor and assess the situation firsthand.

2. Automatic stations: Data collected by automated monitoring stations stationed in key locations to track relevant parameters such as rainfall, temperature, wind speed, etc.

3. Manual stations: Information recorded by manual monitoring stations, where data is collected and documented manually.

4. National Agency for Civil Protection (NACP): Updates and reports received from the NACP regarding the event's status, response efforts, and any relevant developments.

5. Media sources: Information gathered from news reports, broadcasts, and other media outlets reporting on the event.

6. Calculation models of NCFMNH: Data extracted from the calculation models utilized by the National Center for Forecasting and Monitoring of Natural Hazards to predict and analyse the event.

7. Internationally recognized models: Insights and analyses generated by globally recognized models and frameworks used to assess similar events worldwide.

Data Archiving

Data archiving is a critical activity that serves as the foundation for compiling and archiving a diverse range of information. A comprehensive record is established, facilitating future analysis, research, and response planning within the Lezha region:

- Archiving predicted hydrological and meteorological data: This involves storing data obtained from forecasts of precipitation, temperatures, wind patterns, flow rates, and other relevant parameters. The archived data is typically saved in Excel format for easy access and analysis.

- Archiving predicted and observed data on forest fires: This entails preserving both forecasted and observed data related to forest fires. The data includes information obtained from fire forecasts as well as data recorded by the National Civil Protection Agency during actual fire incidents.

5 INTERVENTION MODEL

The Directorate of civil Emergencies is the place where **warnings must translate into action.**

This interplay between early warnings and effective response actions is critical to an understanding of early warning actions. An early warning – informed by the best possible observations, analysis, and scientific forecasting – is useless if it does not result in preventative actions.

This intervention model defines the operational response of the specific territorial levels, taking care their coordinated and gradual activation. In this sense, it assigns decision-making responsibilities to the various levels of command and control and defines a communication system that enables a constant exchange of information.

5.1 Description of the intervention model: The Albanian Civil Protection structure

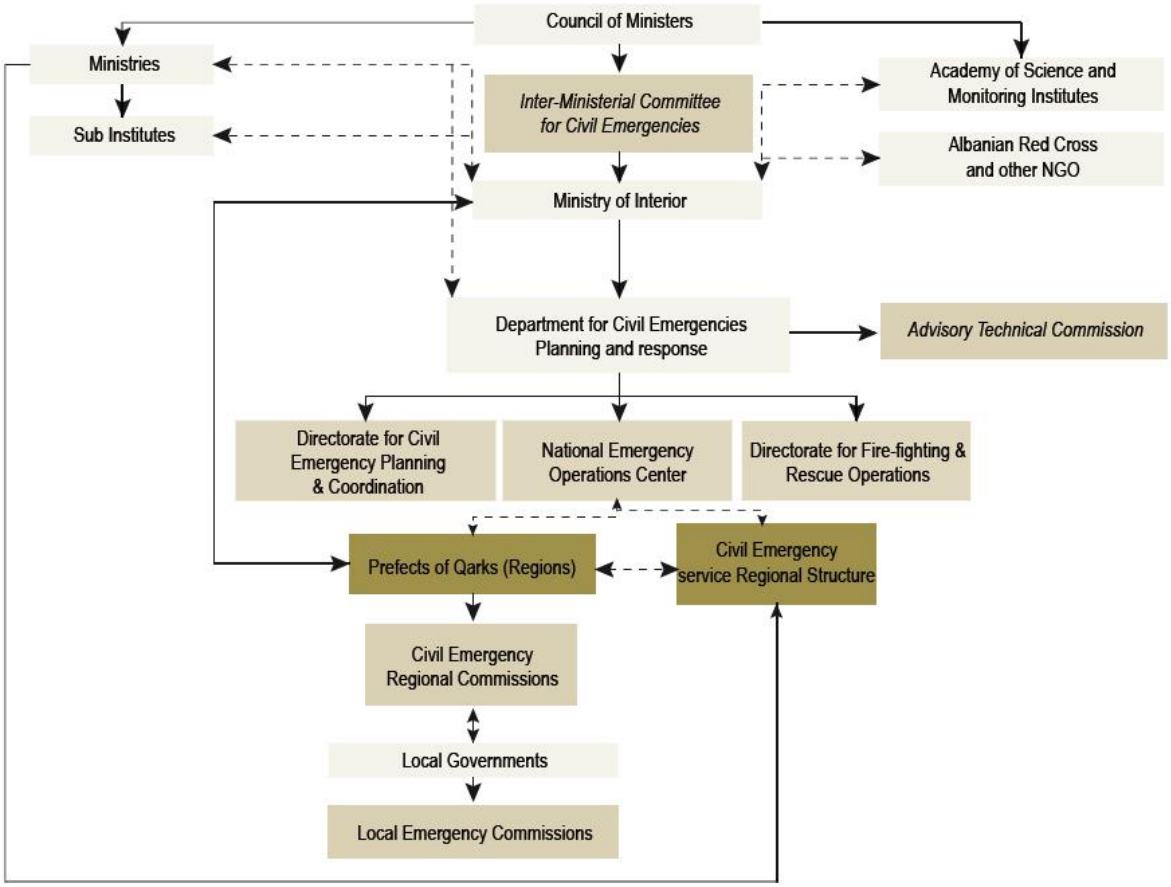


Figure 27: Current Albanian Civil Protection structure.

As stipulated by law, the Department of Civil Emergency, Planning, and Response, under the Ministry of Interior, serves as the national governmental entity entrusted with implementing Civil Protection law at local level.

Managed by a General Director, the Department operates through three core structures (refer to Figure 27):

- The Directorate for Civil Emergency Planning and Coordination.
- The National Emergency Operations Centre.
- The Directorate for Fire Fighting and Rescue (FFR) Operations.

At the central level, the civil emergency staff comprises 13 members, including the General Director and the heads of the Directorates.

In extraordinary circumstances posing severe threats to national security, the Prime Minister holds the authority to declare a National Emergency Situation (Level 1). During this period, typically lasting 10 days, an Inter-Ministerial Committee for Civil Emergency is established by key ministers (including the Minister of Interior, Minister of Defense, Minister of Environment, and Minister of Health). The General Director of Civil Emergency assumes the role of Head of Operations (Level 1).

At the local level, Prefects represent the Department and are responsible for Civil Protection in counties and districts (Level 2 and Level 3). District sub-prefects coordinate local fire brigades, while presidents of communes and municipalities play pivotal roles in managing emergencies within their territories (Level 3).

Prefects and local governments (Level 2 and Level 3) have the authority to convene specific **periodic civil emergency commissions**, typically held monthly. These commissions focus on assessing the i**mplementation** of public works aimed at **risk mitigation** at the municipal or commune level, as well as overseeing the **reconstruction** of public infrastructure damaged or destroyed in previous incidents. However, they do not oversee budgetary matters.

5.1.1 Organization flow of planning, mitigation, and response

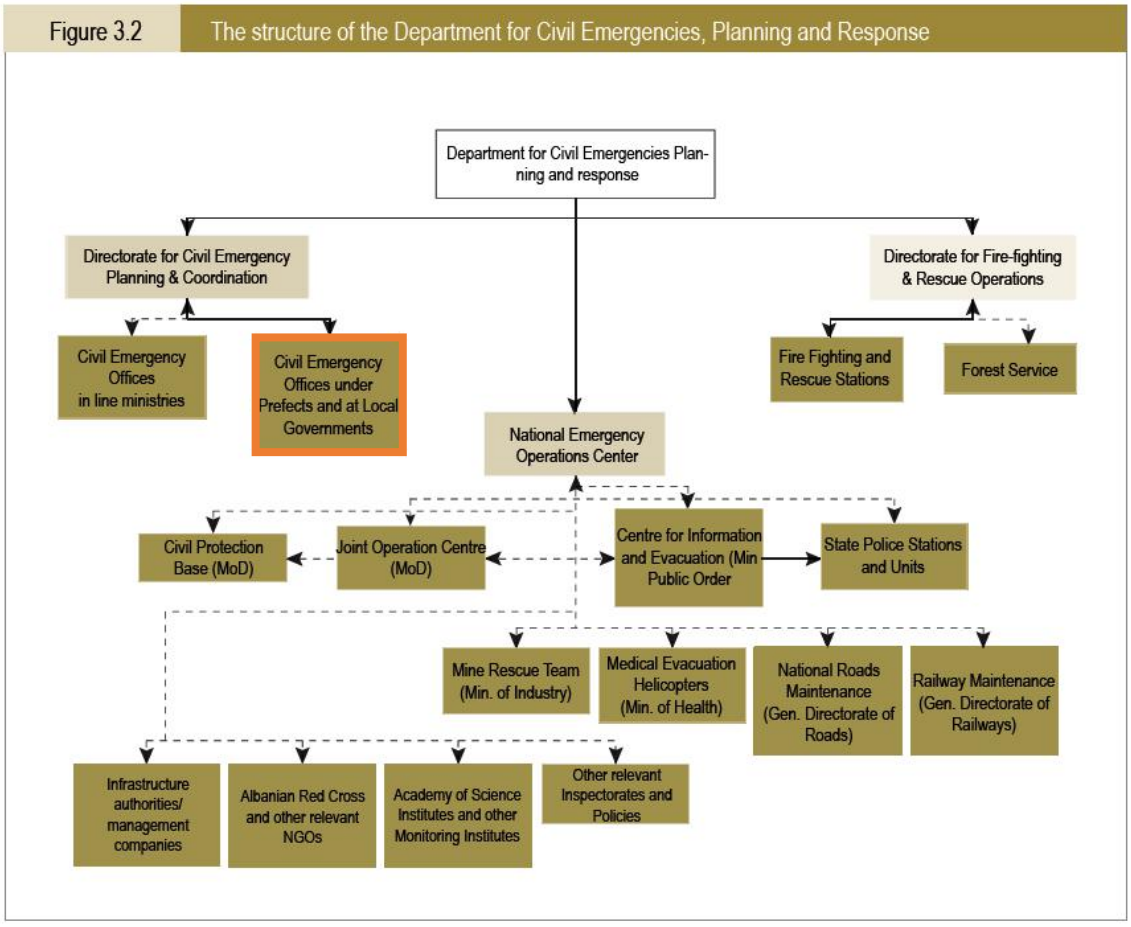


Figure 28: The structure of the department for civil emergencies, Planning and response.

The Department of Civil Emergency, Planning, and Response, along with **its directorates and civil emergency offices under prefects and Local governments** (refer to Figure 28 is entrusted with several key responsibilities:

- Conducting inspections of preventative structural measures implemented within the territory to mitigate natural risks.
- Coordinating all Civil Protection activities at both Level 1 and local levels.
- Providing training and technical guidance to personnel within the Civil Protection framework.
- Establishing cooperation and agreements with regional and international Civil Protection agencies.
- Assessing risks, coordinating resources, and deploying first-response efforts in emergencies.
- Serving as the technical secretariat for the Inter-Ministerial Committee for Civil Emergencies.

The National Emergency Operations Centre (NEOC) assumes a vital role during emergencies, with a diverse range of responsibilities:

Upon receiving assistance requests from prefects, the NEOC collaborates with the State Police to initiate a first-response intervention in the emergency. In the event of a major incident, the NEOC activates the Centre for Information and Evacuation, coordinating its activities accordingly. Additionally, the NEOC collaborates with the Joint Operation Centre, managed by the Ministry of Defense, to dispatch rescue teams from the Civil Protection Base (as outlined in Article 19 of Law 8756/2001).

Furthermore, it has the authority to involve additional operational entities during emergency phases, including public bodies such as the Albanian Red Cross and other NGOs, as well as private companies, (as per Article 25 of Law 8756, March 2001).

Every morning, the National Emergency Operations Centre (NEOC) diligently compiles and sends a detailed report to the General Director of Civil Emergency. This report provides a comprehensive list and description of all emergencies that have occurred within the previous 24 hours in Albania. Additionally, the report includes a succinct weather forecast for the day along with notes highlighting potential critical situations.

The weather forecasting office within the Institute of Energy, Water and Environment receives daily information and data from 15 meteorological stations distributed across Albania. However, it's important to note that the Institute faces limitations in providing reliable and up-to-date meteorological data. There is currently a lack of national remote-sensing data, such as that provided by weather radar, or the type of online data from automated hydrological or meteorological stations necessary for comprehensive emergency management and Civil Protection.

5.1.2 Declaration of emergency situation in flooding events

In the event of flooding, the council of Ministers of the Republic following Decision n. 664, February 2002 may declare a civil emergency situation under specific circumstances:

- When water levels reach critical points in designated control sections.
- If one or more rivers breach their banks, leading to hazardous situations.
- In the case of severe damage to reservoirs or dams.
- When civilian lives, livestock, or property are lost or damaged.

The Department determines the criteria for declaring a civil **emergency based on the impact of the emergency on the affected area and the response capabilities of local government units**, typically at Level 2.

According to procedures for declaring a civil emergency, the Energy, Water and Environment Institute and/or the technical body of local government authorities should provide relevant data to prefects

and/or the NEOC at least every four hours. However, due to resource constraints, the Institute currently cannot guarantee round-the-clock service. Furthermore, communication facilities are not available 24/7, and real-time data from observation stations cannot be automatically collected and transmitted.

The primary operational forces mobilized to manage emergencies of this magnitude include the Army, coordinated by the Ministry of Defense, the Fire Brigade (as outlined in Article 22 of Law 8756, March 2001), the Albanian Red Cross, and contracted private companies at the local or central level. The National Directorate for Fire Fighting and Rescue coordinates firefighting teams through municipal stations under the supervision of district sub-prefects.

5.2 Local Competent Authorities in planning, mitigation, and response

Planning & Mitigation in Lezha involves a structured approach led by key authorities, each with distinct roles and responsibilities. Here's a breakdown of the competent authorities involved and their contributions to flood risk management:

1. UK Lezha (Water Utility):

- Responsible for managing and maintaining the existing and combined sewer drainage system.
- Conducts maintenance activities such as cleaning, inspection, assessment, and repair of sewer infrastructure.
- Coordinates closely with the Municipality of Lezha during flood events, particularly regarding the operation of pumping stations.
- Collaborates with the Municipality to establish a Memorandum of Understanding outlining maintenance responsibilities.

2. Municipality of Lezha:

- Holds primary responsibility for disaster risk management and civil protection at the local level.
- Develops preventive measures and disaster risk management activities tailored to the needs of the community.
- Establishes the Civil Protection Commission (CPC) and oversees its duties, including informing the public, organizing training activities, and making preventive investments.
- Develops documents such as civil emergency plans, risk assessments, and disaster risk reduction strategies.
- Inspects and maintains stormwater infrastructure, including pumping stations, overflows, and drainage channels.

- Receives support and guidance from external consultants and agencies, such as the World Bank and Co-PLAN, for integrating disaster risk management into municipal planning and budgeting.

3. Prefecture of Lezha:

- Oversees civil emergency planning and crisis management within the district.
- Coordinates activities of institutions and structures operating at the district level.
- Facilitates the development of emergency preparedness plans and implementation of protective measures.
- Collects and processes necessary data from municipalities and other district-level structures.
- Coordinates and distributes international assistance during disasters.
- Monitors and ensures the implementation of disaster risk management measures by district municipalities.
- Manages the Emergency Response Department in collaboration with national and local stakeholders, including UK Lezha and the local fire brigade, to effectively respond to flood events.

The Civil Protection Commission (CPC) is established in Lezha in 2020 and is composed as a multi-disciplinary team of **representatives** of the different municipal administration:

- Territorial planning
- Agriculture
- Forest
- Social service
- Education and Youth
- Tourism and Culture
- Institutional Maintenance
- Fire Protection and rescue
- Programming and development
- Administrators of the different communities
- Director of UK Lezha.

Technical secretariate: The General Directorate of Civil Emergencies of the municipality also is established and serves as the technical secretariate of the Civil Protection Commission.

The Civil Protection Commission (CPC) and the municipalities have several **duties** based on the Law 45/2019 "On Civil Protection", such as:

✓ Inform the public and the endangered community

- ✓ Organizee training activities in the field of civil protection for employees and residents in their territory
- ✓ Provide, administer, and update the necessary data that will engage in the prevention and coping of disasters.
- ✓ Make preventive, protective, and rehabilitative investments from disasters.
- ✓ Appoint the head of the operation at municipal level in case of organizing emergency response.

By delineating the roles and responsibilities of these competent authorities, Lezha can implement a comprehensive approach to flood risk management, focusing on prevention, preparedness, and effective response to safeguard lives and livelihood resources in the region.

5.2.1 Communication flow

Creating a clear scheme of communication flow between different territorial levels, stakeholders, institutions, and duty holders is essential for ensuring effective coordination during emergency response operations in Lezha.

Description of Communication Flow:

1. Local Level (Municipality of Lezha):

- The Municipality serves as the frontline authority for disaster risk management and civil protection within its jurisdiction.
- Communication channels include direct contact with local emergency services, such as the fire brigade and medical facilities, to report incidents and request assistance.
- The Civil Protection Commission (CPC), established by the Municipality, serves as a multi-disciplinary team responsible for coordinating emergency response efforts.
- The CPC communicates internally with various departments within the Municipality, such as territorial planning, social services, and education, to mobilize resources and support response activities.
- External communication involves liaising with neighboring municipalities, UK Lezha, and the Prefecture of Lezha to coordinate regional response efforts and share information on the situation.

2. Regional Level (Prefecture of Lezha):

- The Prefecture oversees civil emergency planning and crisis management within the Lezha district.
- Communication flows from the Municipality to the Prefecture, providing situational updates and requesting additional support or resources as needed.
- The Prefecture coordinates activities with other district-level institutions and agencies, such as law enforcement, healthcare facilities, and transportation authorities, to ensure a comprehensive response.

- External communication involves sharing information with neighboring districts and regional agencies to coordinate response efforts and address cross-border impacts of the emergency.

3. National Level (National Emergency Operations Centre, NEOC):

- The NEOC serves as the central coordination hub for emergency response at the national level.
- Communication flows from regional authorities, including the Prefecture of Lezha, to the NEOC, providing updates on the situation and requesting national-level support or resources.
- The NEOC coordinates with relevant national agencies, such as the National Agency for Civil Protection (NACP), Ministry of Health, Ministry of Interior, and Ministry of Defense, to mobilize resources, deploy specialized teams, and provide strategic guidance during emergencies.
- External communication involves sharing information with international partners, such as neighboring countries and international organizations, to facilitate cross-border cooperation and support in response to large-scale emergencies.

5.2.2 Coordination of the activities of institutions and structures operating in district level.

Operational organization.

During the planning process, the Prefecture must identify all the roles and responsibilities of institutions and experts that operate within the EOC (Emergency Operations Centre). In particular, the following items should be carefully defined:

- The Prefecture coordinates the activities of governmental and non-governmental structures in emergency planning through establishing **the Commission for Civil Emergency Planning and Response,** usually called**; "The Commission for Civil protection",** or **"The Commission".**

The Commission for Civil Protection, launched annually at the beginning of October to coincide with the start of the flooding season, operates in accordance with several key legal frameworks, including Law No. 107/2016 "On the Prefect of the District," Law No. 45/2019 "On Civil Protection," Council No. 923 dated 25.11.2020 "On the Functioning and Organization of the Civil Protection Committee and the Inter-Institutional Cooperation of Institutions and Structures of the Civil Protection System," and Instruction No. 16 dated 11.07.2003 "On the establishment and functioning of the commission for planning and meeting civil protection at the district level."

a. The Commission convenes regularly, less than once every three months during normal situations, or on an ad hoc basis when civil emergency situations arise, as determined by the Prefect.

b. It is responsible for drafting civil protection plans at the district level, tailored to potential natural disaster scenarios, and submits them for coordination to the Ministry of Defense and the National Civil Protection Agency.

c. The Commission provides information to the National Operational Center for Civil Emergency and Crisis, both for emergency and normal situations, through its secretary.

d. Training programs and emergency scenario preparations for personnel managing civil emergencies and community preparedness are developed and processed by the Commission.

e. It offers support to district-level operation leaders in managing civil defense efforts.

f. Coordination of activities among intervention forces in emergency situations is facilitated by the Commission.

g. Cooperation with the National Civil Protection Agency and other institutions is undertaken to assess damage caused by natural disasters and other calamities and to repair affected areas.

h. Heads of state institutions at the local level are tasked with re-establishing staff for planning and managing civil emergencies.

i. Similarly, heads of local self-government are responsible for establishing civil protection staff for planning and managing emergency situations within their administrative territories.

j. The organization, scheduling of meetings, consultations, and agenda setting are determined by the Prefecture.

By adhering to these guidelines and operating procedures, the Commission for Civil Protection plays a vital role in ensuring effective preparedness and response to civil emergencies in the district.

- Organization of the operational center through **support functions**
    - support function represents the different areas of competence and intervention into which the Civil Protection systems is subdivided.
    - Examples of support functions are:
        - Social assistance and medical care
        - Logistics
        - Telecommunications
        - Essential services
        - Assistance to the population
        - Volunteering
        - Etc.

- Each function has a specific sector of competence, and it is composed by all stakeholders, organizations and experts that are territorially competent for that subject.
- For each function an institution/organization is identified as "duty holder" and is responsible, on the basis of the existing legal framework and objectives identified by the emergency plan, for the correct implementation of its duties.

- **Stakeholders**
  - During the planning process, a brief description of all involved stakeholders with pre-identified contact persons for each support function is elaborated.
  - Most important stakeholders related to flooding in Lezha are
    - UK Lezha
    - Irrigation board
    - Albanian Red Cross
    - Neighborhood committees in the city
    - Municipality
    - Prefecture
    - Fire brigades.
    - Police

5.2.3 Emergency areas

Emergency areas are places intended for civil protection activities and must be identified in advance in emergency planning.

Within the scope of their responsibilities, local administrations should identify population waiting areas to serve as crucial shelters for residents who need to evacuate their homes during emergencies or in the immediate aftermath of an event.

In Lezha, the municipality has established partnerships with various hotels to provide safe accommodations for individuals and families in need. While the number of families requiring evacuation in Lezha is typically low, these waiting areas play a vital role in ensuring the welfare and safety of those affected by emergencies.

5.2.4 Resources of coping capacity for rescue and emergency assistance

Monitoring of the coping capacity for rescue and emergency assistance in form of a list of stocks available in the municipalities of Kurbin, Mirditë and Lezha.

The General Directorate of Civil Emergencies of the prefecture has the mandate to manage the stock of equipment and resources to cope with emergencies for the municipalities of Kurbin, Mirditë and Lezha. This list contains fire engines, rescue vehicles, digging vehicles, heavy duty transport vehicles, ladders, boats, generators, tents, stoves, sandbags, saws, pumps, etc. as well as first aid items for the sheltered population (portable beds, blankets, sheets, pillows, mattresses, plastic bedding.

See annex "The capacity table for coping with civil emergencies" for the comprehensive list of stocks available in February 2024.

The municipality established partnerships with following hotels for waiting area or temporary shelter:

1. **RAFAELO RESORT** ; 4000-5000 people could be accommodated), location :(https://www.google.com/maps/place/RAFAELO+RESORT+5+STARS/@41.8085466,19.5959656,758m/data=!3m1!1e3!4m20!1m10!3m9!1s0x1351e1523787c93d:0x5e440a606d81a4a3!2sRAFAELO+RESORT+5+STARS!5m2!4m1!1i2!8m2!3d41.8085466!4d19.5985459!16s%2Fg%2F11f7ssyhct!3m8!1s0x1351e1523787c93d:0x5e440a606d81a4a3!5m2!4m1!1i2!8m2!3d41.8085466!4d19.5985459!16s%2Fg%2F11f7ssyhct?entry=ttu).

2. **Hotel Frojd** ;2000 people could be accommodated : (https://www.google.com/maps/place/Hotel+Frojd/@41.8108016,19.5950617,379m/data=!3m1!1e3!4m10!3m9!1s0x1351e15b9171962b:0x78a645bec0720bb0!5m3!1s2024-05-23!4m1!1i2!8m2!3d41.8117188!4d19.5944503!16s%2Fg%2F11q9m17ddt?entry=ttu)

5.2.5 Management and maintenance of the stormwater and sewer drainage system

The approved design for draining the accumulating stormwater from the hillside area of Lezha city is shown in Figure 18.

In general, the authorities are responsible for the stormwater infrastructure and the Water Utilities (UKs) are responsible for the sewerage system.

Sewage infrastructure conveys sewage or runoff, including melt water, rain and stormwater. It ends at the point of entry into a sewage plant or when the sewage is discharged into the environment. The components of sewage infrastructure primarily consist of pipes, but they also include manholes, pumping stations, storm overflows, receiving drains and screening chambers. Sewage systems may be classified into gravity and sanitary sewers. Gravity sewers include simple sewers, combined sewers and storm drains, where sanitary sewers consist of effluent sewers and vacuum sewers.

List of responsible authority for managing and maintaining the following infrastructure:

See fig 18, repeated hereunder.

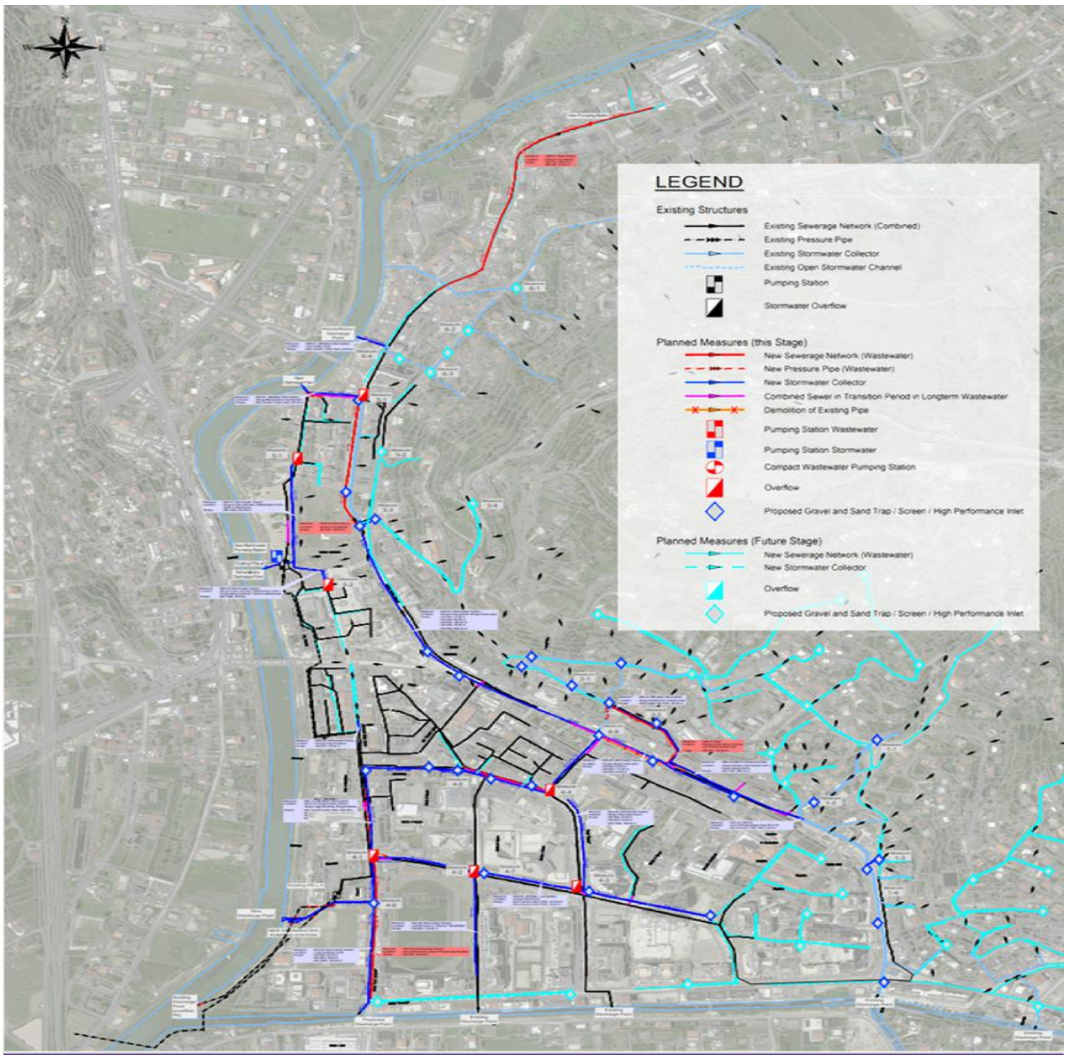


Figure 18: Approved design for draining the accumulating stormwater from the hillside area of Lezha city.

- Stormwater infrastructure (blue colour): Municipality (small pipes along the street) and Drain Board, a department managed by the central government which manages the main collectors or bigger pipes.
- Sewerage infrastructure (red colour): UK Lezha
- Combined sewer (existing; black colour): UK Lezha
- Combined sewer (new; pink colour): UK Lezha
- Pumping station wastewater: UK Lezha
- Pumping station stormwater: Drain Board
- Overflows, gravel and sand traps: Drain Board

An effective maintenance program is essential to the operation of a sewage system. The potential deficiencies of a poorly maintained system include infiltration/inflow (I/I), sanitary sewer overflows (SSOs) and stoppages. Successful sewer infrastructure maintenance consists of the following phases:

- Sewer Infrastructure Cleaning
- Sewer Infrastructure Inspection
- Sewer Infrastructure Assessment
- Sewer Infrastructure Repair

In practice there exists a close cooperation between UK-Lezha and the Municipality of Lezha during flood events. An important factor for responding to each flood event in Lezha city centre is the functioning of the pumping stations operated by UK Lezha.

A ***Memorandum of Understanding*** is recommended to define which maintenance work of the infrastructure is done by UK Lezha and by the municipality.

6 OPERATIONAL PHASES: emergency respond scheme

Given the forecasted criticality provided by the bulletin a hydrological alert level should be foreseen at Prefectural level. The issuance of an alert level will automatically activate an operative phase as reported in the table below.

Hydrological / Hydraulic forecast (IGEWE)	Correspondent alert level adopted by the Prefecture	Minimum Operative phase to be adopted by the entire system
Green	Green	Ordinary activities
Yellow	Yellow	At least Attention phase
Orange	Orange	At least pre-alarm phase
Red	Red	At least pre-alarm phase

Table 8: Schematization of the operative chain which initiates the activation of operative phases at local level stemming from the correspondent forecast and alert level accordingly to the color code in IGEWEs daily bulletin.

6.1 Operative phases

According to the National Civil Emergency Plan, the response to natural and manmade disaster is characterized as "…all actions of forces and means for rescuing people's lives, livestock and property in a territory stricken by a disaster, as well as providing the basic living conditions for the population affected by disaster".

The emergency Response Phase goes through the following Stages:

• *Stage 1:* Alert. All measures on first notification or information on an emergency situation and serves as a signal to increase readiness.
• *Stage 2:* Standby. Readiness of all post notification measures or information that an emergency situation or disaster is imminent or has started.
• *Stage 3:* Activate. Activation arises when an emergency situation has occurred.

Based on Context indicators, and Status indicators prefectural operative phases could be gradually activated as follows:

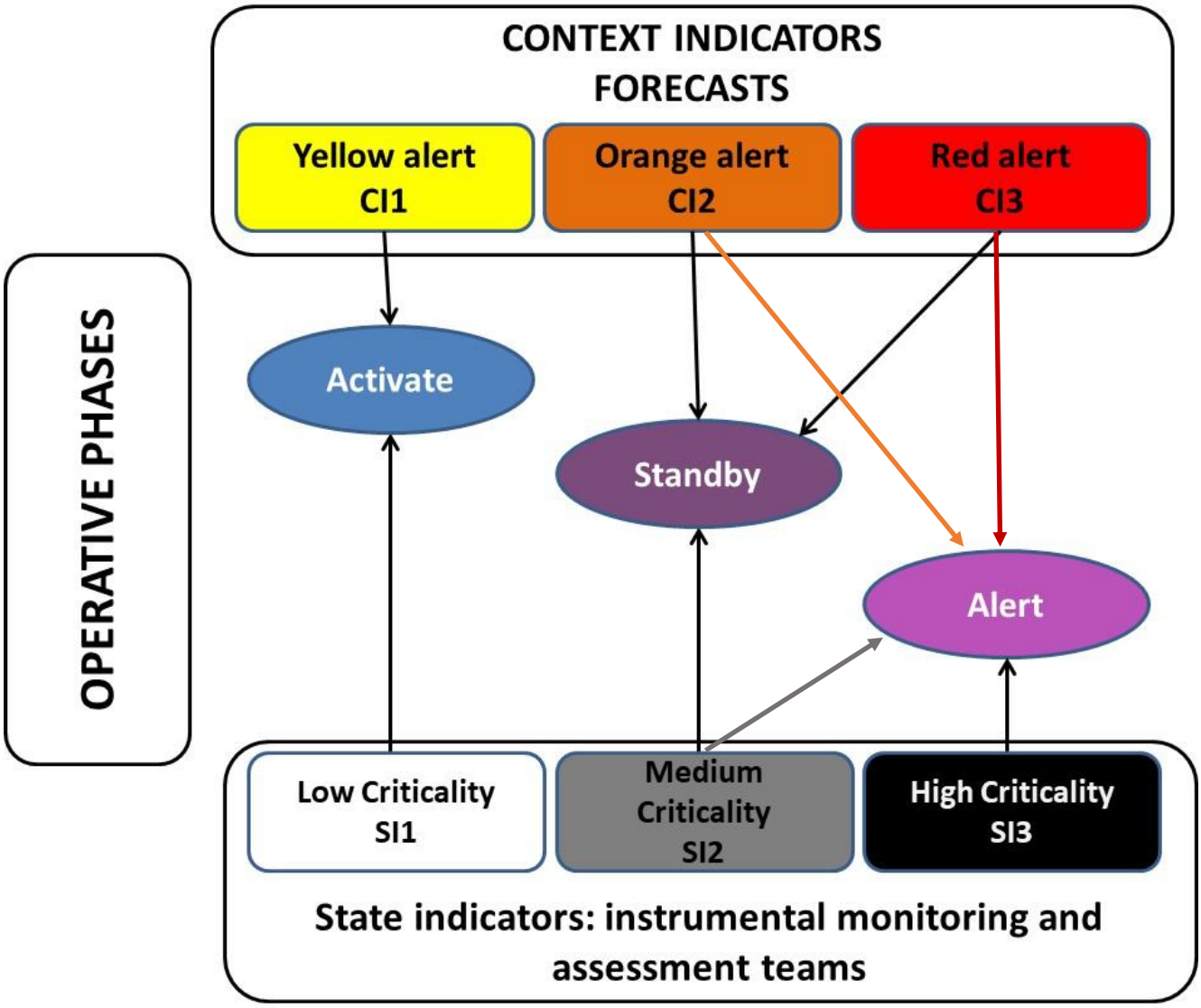


Figure 29: Gradual activation of operational phases

HOW TO READ THIS?

A. Connection with monitoring.

I. Context indicators (CI) refer to forecasts; see section 4.2.
   - Daily IGEWE's bulletin on Natural Hazards

II. State indicators (SI); see section 4.2.
   - instrumental monitoring of water levels,
   - observations of water intake points,
   - Communication of assessment teams deployed in the field,
   - Communication from other institutional stakeholders,

- Population through institutionalized communication channels (emergency numbers)

B. Connection with Hazard, Exposure and Risk Maps. see section 3.3:

- **FLOODING ALERT** will result FROM THREE CIRCUMSTANCES causing flooding in the centre city of Lezha:

1st. when both indicators CI 3 and SI 3 show the following:

- **SI3 High critically** = flooding condition of the Manatia river in combination with
- **CI3 orange alert**; Tn = 2 to 3; a rain event exceeding recurring every 3 to 5 years

This circumstance refers to Fig 16; Load case 2a; rain events with small intensity with flooding river water level.

OR

2nd. when both indicators CI 3 and SI 2 show the following:

- **SI2 Medium critically** = significant backpressure (normal water level) of the Manatia river in combination with
- **CI3 red alert**; Tn= 20 a = rain event recurring every 20 years

This circumstance refers to Fig 15; Load case 1a; rain events with high intensity with medium river water level.

OR

3rd. when both indicators CI 3 en SI 3 show

- **SI3 High critically** = flooding condition of the Manatia river in combination with
- **CI3 red alert**; Tn= 20 a = rain event recurring every 20 years

- **STANDBY:** This operative phase will result in the activation of the storm water pumps. The activation of stormwater pumping stations hinges on river water levels. When river water levels rise, the installed penstocks in the stormwater box-culverts are closed, triggering the activation of the pumping stations.

This circumstance refers to Fig 17: Load case 1b; activation of stormwater pumps related to river water levels.

6.2 Response scheme

A proposal of a scheme is herewith provided:

6.2.1 Territorial assessment teams

Activities of assessment teams are conducted in a dynamic way. According to pre-established routes (to be developed with a participatory procedure including the population and all stakeholders in their determination) and control cards (see Figure 30), personnel from the prefectures or municipalities, trained volunteers and other designed experts use recognizable vehicles possibly equipped with radio and / or telephone communications systems. These operate in constant contact with prefectural Civil Protection Commission. Communication with control cards can happen via smartphones or other electronic devices BUT physical cards must be provided in every case as internet providers can face interruptions of services.

The operators of the assessment teams periodically provide to the operators of the Emergency Operation Center (EOC) information of their observations.

The table below is a proposal of scheme that clarifies the activation and duties of assessment activities under various emergency operational phases:

Table 9: Activities of the assessment Team

Activities of the assessment team	Activate	Standby	Alert	Supporting institutions	Person in the EOC who activates the teams
Assessment team	No action required	1 assessment team operating 24/7	2 assessment teams, volunteering organization and necessary personnel in support of EOC decisions	Civil Emergency commission established in the municipality; UK Lezha, Irrigation board, Albanian red Cross	Team leader of each Supporting institutions
Team leader	No action required	Communicates every 2 hours or at the insurgence of any relevant phenomenon with the Directorate of civil emergencies Lezha	assessment teams activated 24h/24h	UK Lezha, Irrigation board, Albanian red Cross, Fire brigades, police	Directorate of civil emergencies Lezha in communication with NEOC

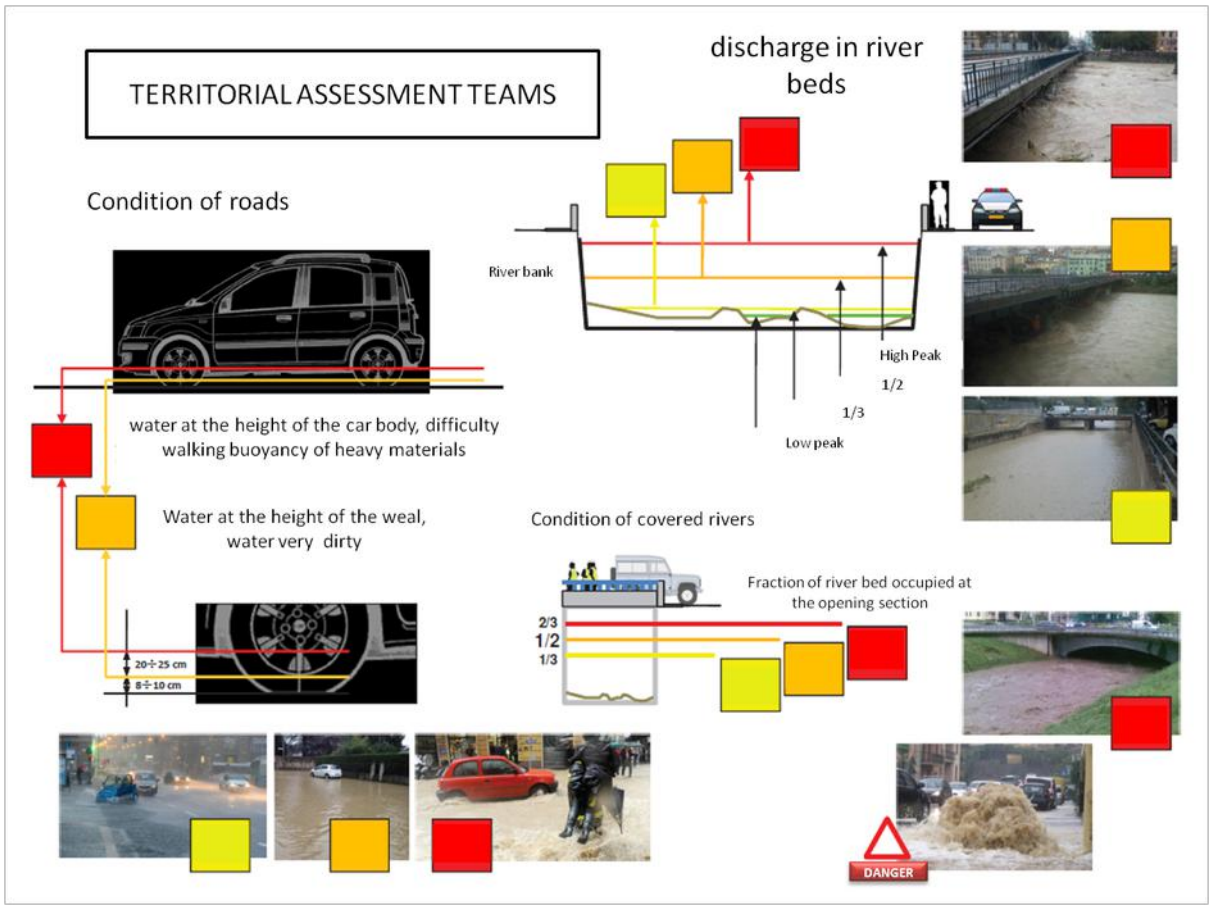


Figure 30 Example of control cards

6.2.2 Response scheme in case of flooding alert

The response scheme to cope with a flooding alert in Lezha involves a systematic and coordinated approach to mitigate risks, ensure public safety, and minimize the impact of the flood event in 10 phases.

1. Early Warning System Activation:

- Upon receiving a flooding alert from relevant authorities or monitoring systems, the early warning system is activated to disseminate alerts to the public and emergency responders.

2. Alerting and Communication:

- Alerts are issued to the local population through various channels, including SMS notifications, sirens, social media, and local media outlets, informing them of the flooding risk and necessary actions to take.

- Emergency response teams and relevant stakeholders are notified and instructed to prepare for response actions.

3. Emergency Operations Center Activation:

- The Emergency Operations Center (EOC) is activated to serve as the central command and coordination hub for response activities. Key personnel from various agencies convene at the EOC to coordinate response efforts.

4. Evacuation Planning and Execution:

- Evacuation plans are activated for residents in high-risk areas prone to flooding. Designated evacuation routes, assembly points (hotels), and transportation arrangements are established.

- Emergency responders, including police, fire departments, and civil defense teams, assist with the orderly evacuation of residents to safe locations.

5. Resource Mobilization:

- Adequate resources, including personnel, equipment, and supplies, are mobilized to support response efforts. This may include deploying additional rescue teams, boats, pumps, and emergency shelters.

- Mutual aid agreements with neighboring jurisdictions and external agencies are activated to facilitate resource sharing and support.

6. Public Safety Measures:

- Public safety measures are implemented, including road closures, traffic management, and evacuation orders, to prevent accidents and ensure the safety of residents and responders.

- Public information campaigns are conducted to educate residents on flood risks, evacuation procedures, and safety precautions.

7. Monitoring and Assessment:

- Continuous monitoring of flood levels, weather conditions, and infrastructure integrity is conducted to assess the evolving situation and anticipate potential impacts.

- Damage assessment teams are deployed to evaluate the extent of flood damage and prioritize response efforts.

8. Community Support and Assistance:

- Community support centers are established to provide assistance and support to affected residents, including temporary shelter, food, and medical aid.

- Volunteer organizations and community groups are mobilized to assist with relief efforts and provide support to vulnerable populations.

9. Recovery and Rehabilitation:

- Once the floodwaters recede, efforts shift towards recovery and rehabilitation. This includes debris removal, infrastructure repair, and support for affected communities to rebuild and recover.

10. After-Action Review:

- Following the flood event, an after-action review is conducted to evaluate the effectiveness of response efforts, identify lessons learned, and make recommendations for improving future response capabilities.

7 INFORMATION AND COMMUNICATION TO POPULATION

The main objective of an emergency plan is that of defining all the necessary means and protocols to correctly communicate with the population the main activities and behavioural codes to enact during an emergency.

7.1 Information & Communication

In this section the following should be described:

- Existing means of information
  - List all media channels used by the prefecture to disseminate information to the population.
  - Detail timings (who does what and precisely at what time?) and contents (what is the content of the message?) of warnings.
- Explanation of how population is informed, official channels, media, etc.

0 APPENDIX

1 EXERCISES

Organisations should consider exercising with partner agencies and contracted services where the identified risks and the involvement of partner organisations is appropriate. Learning from exercises must be cultivated into developing a method that supports personal and organisational goals and is part of an annual plan validation and maintenance programme.

Exercises should be constantly promoted at Prefectural and Municipal level.

Main focus of the exercises should be that of testing:

- command and control chains
- Effectiveness of communication flows and protocols
- Knowledge of main stakeholders involved in Civil Protection activities of the plan contents
- Sharing of information from local to national level
- Existence of adequate support structures to implement the plan
- Feasibility of the plan in all of its parts
- Communication of alert and warnings to the population

This part will be elaborated at the end of the second year of the project with the objective to start implementation of Yearly simulation of disaster risk reaction in the third year of the project.

2 Awareness raising on early warning and DRM

2.1 Why isa Strategy on early warning and DRM needed

Numerous initiatives led by national stakeholders and partners have been implemented to raise citizens' awareness regarding the importance of prevention and preparedness. Despite these efforts, there is still a significant distance to cover in achieving the necessary level of education, especially considering the heightened hazard and risk levels observed over the past decade. Unprecedented flood events, such as those in the Drini river delta and downstream of the Vjosa river, underscore the urgent need for not only technical adaptations but also proactive communication with affected communities to foster behavioral change.

Therefore, this section aims to establish a platform for active communication, message delivery, and practical measures at both the national and prefecture levels, aligning with the Emergency Plan. This initiative should be undertaken as a yearly activity coordinated by responsible stakeholders across all levels and involving various affected groups.

The actions outlined will be grounded in the principles of the "United Nations Sendai Framework for Disaster Risk Reduction 2015-2030," with particular emphasis on the following priorities:

- Promoting national strategies to enhance public education and awareness in disaster risk reduction. This includes disseminating disaster risk information and knowledge through campaigns, social media platforms, and community mobilization, while considering the specific needs of diverse audiences.

- Strengthening collaboration among local communities in Lezha to facilitate the dissemination of disaster risk information. This involves engaging community-based organizations and non-governmental organizations to ensure effective communication and outreach efforts at the grassroots level.

2.1.1 Potential synergies

Making Cities Resilient 2030; https://mcr2030.undrr.org/

Is your city resilient? Does its resilience help its citizens to prosper and flourish? Join other cities on a pathway to resilience – making the city safer, preventing risks and promoting innovation and investments.

Making Cities Resilient 2030 (MCR2030) stands as a distinctive cross-stakeholder initiative dedicated to enhancing local resilience by advocating for change, fostering the exchange of knowledge and experiences, and facilitating the establishment of interconnected city-to-city learning networks. This initiative is characterized by its commitment to injecting technical expertise, fostering collaboration across multiple layers of government, and forging partnerships among diverse stakeholders.

At its core, MCR2030 offers a clear and structured 3-stage roadmap to urban resilience, providing cities with the guidance they need to navigate the complexities of risk reduction and resilience-building efforts. Additionally, MCR2030 equips cities with a suite of tools, grants access to invaluable knowledge resources, and offers robust monitoring and reporting mechanisms. Through these comprehensive supports, MCR2030 empowers cities to embark on their journey towards risk reduction and resilience enhancement effectively.

2.2 Goals, objectives, strategies and tactics of the Awareness strategy

2.2.1 Goal

Safer communities and properties through better information and behavior change towards natural hazards and risks.

2.2.2 Specific objectives

Affected communities know about early warning systems.

Affected communities understand the hazard and risk and behave properly.

Affected communities are regularly and intensively informed.

2.2.3 Main message

An example from a campaign in Tirana: *"Risk is a choice, not a chance" [Risku nuk është FAT, është ZGJEDHJE]*

It is highly recommended that this key message is crafted as a result of a thorough exploration for a distinct name that resonates deeply with the local community of Lezha. It is crucial that this message is consistently communicated across all informational materials and serves as the primary

communication phrase to effectively capture the audience's attention and convey essential information.

2.3 Development of a work plan

2.3.1 Setting the framework for the expected knowledge result

The table below outlines the anticipated knowledge outcomes that all audiences, both collectively and in specific groups, should comprehend, grasp, and effectively employ before, during, and after a disaster event. This knowledge dissemination is intended to occur throughout the year or during specific quarters, aligning with the pertinent issues and the Albanian context concerning Disaster Risk Reduction (DRR), particularly focusing on floods. Each knowledge outcome is strategically mapped out in the following diagram, correlating with timeframes, target groups, and communication tools. Additionally, accompanying this communication strategy are detailed communication tools, as listed in the annexes, which will be available in hard copy format to supplement the dissemination process.

While the knowledge outcomes are presented at a macro level, the implementation of these outcomes through communication tools is meticulously detailed in each tool. For instance, leaflets outlining steps to take during a flood event or guidelines on interpreting emergency signals provide specific guidance.

It is essential that activities aimed at disseminating these messages with the ultimate goal of achieving behavioral change are conducted regularly and repetitively.

2.3.2 The importance of consistent messaging[7]

Research underscores the critical importance of consistent and repeated messaging in public education for Disaster Risk Reduction (DRR). When messages are conflicting, unclear, or inconsistent, they can lead to confusion, apathy, mistrust, and ultimately, inaction. Furthermore, individuals seek confirmation of these messages from a wide array of authorities. Therefore, it is imperative to establish and communicate a comprehensive set of key messages, ensuring their universal alignment while allowing for contextual variations in language, culture, and communication channels.

Achieving safety and resilience necessitates significant behavioral changes, which are only feasible when the public perceives widespread adoption of these behaviors. To effectively promote behavioral change, it is essential for individuals to comprehend the rationale behind specific measures and to feel both convinced of their efficacy and empowered to implement them. To achieve this, the following communication sequences are proposed; table 10.

[7] International Federation of Red Cross and Red Crescent Societies: “Public awareness and public education for disaster risk reduction: key messages”

Important:

The selection of the knowledge result to achieve and the tools to be used for message distribution should be based on the geographical and the risk situation of Lezha. Focusing on flood areas means that flood is the main risk but other important risks – landslides and forest fire - can be discussed in relation.

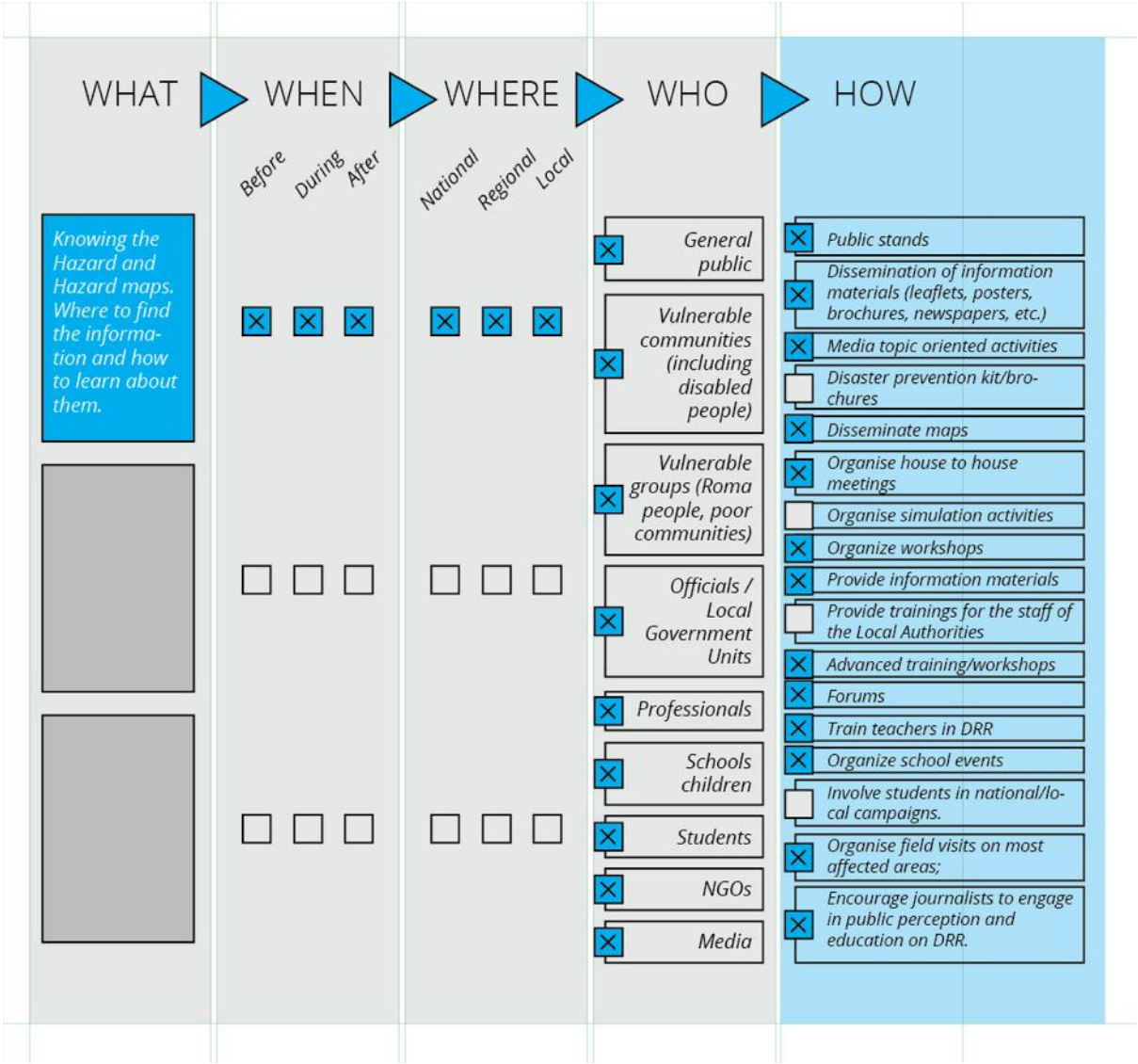
Table 10: messaging scheme for Disaster Risk Reduction (DRR)

	What?	When? to disseminate the message / information Time frame (seasons)				Who? (Responsible body and partners)	Strategic approach (No. xx) below
		Q1	Q2	Q3	Q4		
1	**Know about Emergency Plans (National and local)** **Build on Sendai Framework** • Understanding disaster risk • Strengthening disaster risk governance to manage disaster risk • Investing in disaster risk reduction for resilience • Enhancing disaster preparedness for effective response, and to «Build Back Better» in recovery, rehabilitation and reconstruction	√				GDCE Prefectures Municipalities	1
2	**Know about your institution emergency plan**	√				The related institution like schools	2
3	**Know about Early Warning Systems and how to get informed on time**	√				IGJEUM Prefectures	3
4	**Know the terminology and the right information about DRR, CE and floods** • Understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment	√		√		GDCE Prefectures Municipalities Schools	4

5	**Know about specific risk management plans especially flood management plans**	**√**		**√**		Regional Councils Municipalities Prefectures	5
6	**Know about national, European and international framework in DRR and flood management**	**√**				GDCE Universities	6
7	**Know about responsible authorities and main contact persons in case of emergency**	**√**				GDCE Prefectures Municipalities	7
8	**Knowing the Hazard and Hazard maps. Where to find the information and how to learn about them.**	**√**		**√**		GDCE Prefectures Municipalities Schools	8
9	**Know about main communication channels before during and after an emergency**	**√**		**√**		Prefectures Municipalities	9
10	**Know what actions are needed to reduce risks**	**√**		**√**		Prefectures Municipalities Schools	10
11	**Know specifics of evacuations in case of emergency**	**√**		**√**		Prefectures Municipalities Schools	11
12	**Know about technical measures and innovative solutions on how to prevent and adapt to emergencies and especially flood risk**	**√**				GDCE schools	12

2.3.3 Communication approach

The strategic approach will be designed as a learning mechanism towards behavior change based on achieving the knowledge level result by focusing on the following logic: **What? When? Where? Who? How?**



WHAT	WHEN			WHERE			WHO	HOW
1	Before	During	After	National	Regional	Local		
Know about Emergency Plans (National and local) **Build on Sendai Framework** • Understanding disaster risk • Strengthening disaster risk governance to manage disaster risk • Investing in disaster risk reduction for resilience • Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction	☒	☐	☒	☒	☒	☒	☒ General Public ☒ Vulnerable Communities ☒ Vulnerable groups ☒ Officials ☒ Professionals ☒ Schools ☒ Students ☒ NGOs ☒ Media	☐ Public stands ☐ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☒ Media topic oriented activities ☐ Disaster prevention kit/brochures ☒ Disseminate maps ☐ Organise house to house meetings ☐ Organise simulation activities ☒ Organize workshops ☒ Provide information materials ☐ Provide trainings for the staff of the Local Authorities ☐ Advanced training/workshops ☐ Forums ☐ Train teachers in DRR ☒ Organize school events ☐ Involve students in national/local campaigns. ☐ Organise field visits on most affected areas; ☐ Encourage journalists to engage in public perception and education on DRR.

WHAT	WHEN			WHERE			WHO	HOW
2	Before	During	After	National	Regional	Local		
Know about your institution emergency plan	☒	☐	☐	☐	☒	☒	☒ General Public ☒ Vulnerable Communities ☒ Vulnerable groups ☒ Officials ☒ Professionals ☒ Schools ☐ Students ☐ NGOs ☐ Media	☒ Public stands ☒ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☐ Media topic oriented activities ☐ Disaster prevention kit/brochures ☒ Disseminate maps ☒ Organise house to house meetings ☐ Organise simulation activities ☒ Organize workshops ☒ Provide information materials ☐ Provide trainings for the staff of the Local Authorities ☐ Advanced training/workshops ☐ Forums ☐ Train teachers in DRR ☒ Organize school events ☐ Involve students in national/local campaigns. ☐ Organise field visits on most affected areas; ☒ Encourage journalists to engage in public perception and education on DRR.

WHAT	WHEN			WHERE			WHO	HOW
3	Before	During	After	National	Regional	Local		
Know about Early Warning Systems and how to get informed on time	☒	☐	☐	☒	☒	☒	☒ General Public ☒ Vulnerable Communities ☒ Vulnerable groups ☒ Officials ☒ Professionals ☒ Schools ☒ Students ☒ NGOs ☒ Media	☐ Public stands ☒ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☒ Media topic oriented activities ☐ Disaster prevention kit/brochures ☐ Disseminate maps ☐ Organise house to house meetings ☐ Organise simulation activities ☒ Organize workshops ☒ Provide information materials ☒ Provide trainings for the staff of the Local Authorities ☐ Advanced training/workshops ☐ Forums ☐ Train teachers in DRR ☐ Organize school events ☐ Involve students in national/local campaigns. ☐ Organise field visits on most affected areas; ☒ Encourage journalists to engage in public perception and education on DRR.

WHAT	WHEN			WHERE			WHO	HOW
4	Before	During	After	National	Regional	Local		
Know the terminology and the right information about DRR, CE and floods Understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment	☒	☐	☒	☒	☒	☒	☒ General Public ☒ Vulnerable Communities ☒ Vulnerable groups ☒ Officials ☒ Professionals ☒ Schools ☒ Students ☒ NGOs ☒ Media	☒ Public stands ☒ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☒ Media topic oriented activities ☐ Disaster prevention kit/brochures ☐ Disseminate maps ☒ Organise house to house meetings ☐ Organise simulation activities ☒ Organize workshops ☒ Provide information materials ☒ Provide trainings for the staff of the Local Authorities ☒ Advanced training/workshops ☐ Forums ☒ Train teachers in DRR ☒ Organize school events ☒ Involve students in national/local campaigns. ☒ Organise field visits on most affected areas; ☒ Encourage journalists to engage in public perception and education on DRR.
WHAT	**WHEN**			**WHERE**			**WHO**	**HOW**

5	Before	During	After	National	Regional	Local		
Know about specific risk management plans especially flood management plans	☒	☐	☐	☐	☒	☒	☒ General Public ☒ Vulnerable Communities ☒ Vulnerable groups ☒ Officials ☐ Professionals ☒ Schools ☐ Students ☒ NGOs ☐ Media	☒ Public stands ☒ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☒ Media topic oriented activities ☐ Disaster prevention kit/brochures ☒ Disseminate maps ☒ Organize house to house meetings ☐ Organize simulation activities ☒ Organize workshops ☒ Provide information materials ☐ Provide trainings for the staff of the Local Authorities ☒ Advanced training/workshops ☐ Forums ☒ Train teachers in DRR ☒ Organize school events ☒ Involve students in national/local campaigns. ☒ Organize field visits on most affected areas; ☒ Encourage journalists to engage in public perception and education on DRR.
WHAT	**WHEN**			**WHERE**			**WHO**	**HOW**

6	Before	During	After	National	Regional	Local		
Know about national, European and international framework in DRR and flood management	☒	☐	☐	☒	☒	☒	☐ General Public ☐ Vulnerable Communities ☐ Vulnerable groups ☒ Officials ☒ Professionals ☐ Schools ☐ Students ☒ NGOs ☒ Media	☐ Public stands ☒ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☒ Media topic oriented activities ☐ Disaster prevention kit/brochures ☐ Disseminate maps ☐ Organize house to house meetings ☐ Organize simulation activities ☒ Organize workshops ☐ Provide information materials ☒ Provide trainings for the staff of the Local Authorities ☒ Advanced training/workshops ☒ Forums ☐ Train teachers in DRR ☐ Organize school events ☐ Involve students in national/local campaigns. ☐ Organize field visits on most affected areas; ☒ Encourage journalists to engage in public perception and education on DRR.

WHAT	WHEN			WHERE			WHO	HOW
7	Before	During	After	National	Regional	Local		
Know about responsible authorities and main contact persons in case or emergency	☒	☐	☐	☒	☒	☒	☒ General Public ☒ Vulnerable Communities ☒ Vulnerable groups ☒ Officials ☒ Professionals ☒ Schools ☐ Students ☒ NGOs ☒ Media	☒ Public stands ☒ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☒ Media topic oriented activities ☐ Disaster prevention kit/brochures ☐ Disseminate maps ☐ Organize house to house meetings ☐ Organize simulation activities ☒ Organize workshops ☐ Provide information materials ☐ Provide trainings for the staff of the Local Authorities ☐ Advanced training/workshops ☒ Forums ☒ Train teachers in DRR ☒ Organize school events ☐ Involve students in national/local campaigns. ☐ Organize field visits on most affected areas; ☒ Encourage journalists to engage in public perception and education on DRR.

WHAT	WHEN			WHERE			WHO	HOW
8	Before	During	After	National	Regional	Local		
Knowing the Hazard and Hazard maps. Where to find the information and how to learn about them.	☒	☐	☐	☒	☒	☒	☒ General Public ☒ Vulnerable Communities ☒ Vulnerable groups ☒ Officials ☒ Professionals ☒ Schools ☒ Students ☒ NGOs ☒ Media	☒ Public stands ☒ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☐ Media topic oriented activities ☐ Disaster prevention kit/brochures ☒ Disseminate maps ☒ Organize house to house meetings ☐ Organize simulation activities ☒ Organize workshops ☒ Provide information materials ☒ Provide trainings for the staff of the Local Authorities ☒ Advanced training/workshops ☒ Forums ☒ Train teachers in DRR ☒ Organize school events ☐ Involve students in national/local campaigns. ☐ Organize field visits on most affected areas; ☒ Encourage journalists to engage in public perception and education on DRR.

WHAT	WHEN			WHERE			WHO	HOW
9	Before	During	After	National	Regional	Local		
Know about main communication channels before during and after an emergency	☒	☐	☐	☒	☒	☒	☒ General Public ☐ Vulnerable Communities ☐ Vulnerable groups ☒ Officials ☒ Professionals ☒ Schools ☐ Students ☒ NGOs ☒ Media	☒ Public stands ☒ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☒ Media topic oriented activities ☒ Disaster prevention kit/brochures ☐ Disseminate maps ☐ Organize house to house meetings ☐ Organize simulation activities ☒ Organize workshops ☒ Provide information materials ☒ Provide trainings for the staff of the Local Authorities ☐ Advanced training/workshops ☐ Forums ☒ Train teachers in DRR ☒ Organize school events ☐ Involve students in national/local campaigns. ☐ Organize field visits on most affected areas; ☒ Encourage journalists to engage in public perception and education on DRR.

WHAT	WHEN			WHERE			WHO	HOW
10	Before	During	After	National	Regional	Local		
Know what actions are needed to reduce risks	☒	☐	☒	☒	☒	☒	☒ General Public ☒ Vulnerable Communities ☒ Vulnerable groups ☐ Officials ☐ Professionals ☒ Schools ☐ Students ☒ NGOs ☒ Media	☒ Public stands ☒ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☒ Media topic oriented activities ☒ Disaster prevention kit/brochures ☒ Disseminate maps ☒ Organize house to house meetings ☐ Organize simulation activities ☒ Organize workshops ☒ Provide information materials ☒ Provide trainings for the staff of the Local Authorities ☐ Advanced training/workshops ☐ Forums ☒ Train teachers in DRR ☒ Organize school events ☒ Involve students in national/local campaigns. ☒ Organize field visits on most affected areas; ☒ Encourage journalists to engage in public perception and education on DRR.

WHAT	WHEN			WHERE			WHO	HOW
11	Before	During	After	National	Regional	Local		
Know specifics of evacuations in case of emergency	☒	☐	☒	☐	☒	☒	☒ General Public ☒ Vulnerable Communities ☒ Vulnerable groups ☒ Officials ☒ Professionals ☒ Schools ☒ Students ☒ NGOs ☒ Media	☒ Public stands ☒ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☒ Media topic oriented activities ☒ Disaster prevention kit/brochures ☒ Disseminate maps ☒ Organize house to house meetings ☐ Organize simulation activities ☒ Organize workshops ☒ Provide information materials ☒ Provide trainings for the staff of the Local Authorities ☒ Advanced training/workshops ☒ Forums ☒ Train teachers in DRR ☒ Organize school events ☒ Involve students in national/local campaigns. ☒ Organize field visits on most affected areas; ☒ Encourage journalists to engage in public perception and education on DRR.
WHAT	**WHEN**			**WHERE**			**WHO**	**HOW**

12	Before	During	After	National	Regional	Local		
Know about technical measures and innovative solutions on how to prevent and adapt to emergencies and especially flood risk	☒	☐	☒	☒	☒	☒	☒ General Public ☐ Vulnerable Communities ☐ Vulnerable groups ☒ Officials ☒ Professionals ☐ Schools ☒ Students ☒ NGOs ☐ Media	☒ Public stands ☒ Dissemination of information materials (leaflets, posters, brochures, newspapers, etc.) ☐ Media topic oriented activities ☐ Disaster prevention kit/brochures ☐ Disseminate maps ☐ Organize house to house meetings ☒ Organize simulation activities ☐ Organize workshops ☒ Provide information materials ☒ Provide trainings for the staff of the Local Authorities ☒ Advanced training/workshops ☐ Forums ☒ Train teachers in DRR ☐ Organize school events ☐ Involve students in national/local campaigns. ☐ Organize field visits on most affected areas; ☐ Encourage journalists to engage in public perception and education on DRR.

2.4 Developing the information dissemination tools - HOW

2.4.1 Public stands

Tool	Public stand
Description	A 3 x 3 mt yellow gazebo as info-points set up in squares of the chosen municipalities
Purpose	Point of attraction for citizens; the color is the same of the campaign brand to easily identify
Target audience	All citizens
Its use	The focal point in which volunteers gather informative materials to distribute, and nearby volunteers answer to the citizens' questions on the possible actions to carry out to reduce risks
Attached product	Banner of the campaign and logo

2.4.2 Disaster events - showcase

Tool	News articles
Description	The real news on the previous events of floods which best describe the event and give evidence of it. Not articles of reports from authorities.
Purpose	News facts are real facts and people have no doubts of those and best serve to bring their memory back to the news they might have seen on TV.
Target audience	All citizens
Its use	Hang them around the tent and try to make them as visible as possible by printing in large formats. As many news as possible and as factual as possible. Volunteers on the stand can engage with the visitors to discuss on what happened and what they have learned and well as give them tips on how to prepare for the potential next event.
Attached product	None. To be printed every time going on the squares.

2.4.3 Tools and information on early warning and emergency plans

Tool	Hydro metrological stations and parts of the weather bulletin etc.
Description	It is possible to arrange the demonstration of collecting data (pouring water into the funnel) and displaying them on the web infrastructure (www.acronetwork.org)
Purpose	Inform and educate on early warning and how to understand signals and operational phases of a plan. Learn about plans and safe paths and areas.
Target audience	All citizens
Its use	Present them in a very friendly way like printing in large formats the main elements of the products, which possible contain schema, charts and maps.
Attached product	The station can be brought by the authorities. Other materials to be printed every time going on the squares as products might get updated regularly.

2.4.4 Communication materials – leaflets, video, games, etc.

Tool	Banner with logo of the campaign, Leaflets with tips, cards, games, educational video, questionnaires, discussion corners, stickers, T-shirts, hats, etc.
Description	Banner with big picture reproducing the brand, the partner's logo and the website address of the campaign A folded flyer (as big as a newspaper) with a few images and some contents about risk prevention (attitudes and practical actions). A plasticized paper that can store and be hanged up, with simple images and short phrases about rules of behavior "Raindrop curtain" a sort of curtain realized with twines and paper drops, containing pictures and contents related to flood risk
Purpose	Banner for campaign advertising Leaflet for raising citizens risk awareness before the event Card for raising citizens risk knowledge during and after the event Raindrop curtain to disseminate in a playful way campaign contents about flood risk
Target audience	All citizens
Its use	Banner applied on the top of the gazebo, it promotes the initiative and stimulates a deepest knowledge of the proposed topics. The flyer explains in a clear language what the citizen needs to learn to prevent flood damages and how to deal at best with emergency situations and what he can do to reduce flood risk. Card contains useful information for families on the rules of behavior to adopt during the alert, during and right after a flood. The raindrop curtain is used to improve the communication between volunteers and citizens, with simple questions and answers to stimulate rules of behavior
Attached product	Banner, card, leaflet, raindrop curtain

2.5 Evaluation

Matrix of indicators

Objective	Indicators	Target	Means	Sources	Responsible body
1. Affected communities in Lezha know about early warning systems	• No. of people participated at events • No. of people engaged in discussions	• 500 people/year • > 50 people / event	• Pictures, questionnaires, event reports, list of people responded to surveys	• Outdoor event reports	• GDCE and partners
2. Affected communities in Lezha understand the hazard and risk and behave properly	• No. of people informed on the risk • No. of people who report changing habits	• 1000 people are informed on site and online • > 10 people / year report on at least one measure taken	• Analytic reports form online platforms, analytic report from site events, pictures • Statements given by people with name and measure taken	• Online platform analytics • Database of reports	• GDCE and partners
3. Affected communities in Lezha are regularly and intensively informed	• No. of events organized per year • One dedicated communication online platform is established	• At least 3 events per year are organized • Website is online starting from year 2018	• Event reports and pictures • Existence of the website	• File of with the report stored • Website	• GDCE and partners

3 Flood resilient construction of buildings.

Question: How to improve the resilience of properties in low or residual flood risk areas using suitable materials and construction details?

3.1 Flooding considerations

3.1.1 What are the causes of flooding?

The rationale behind flood risk management for buildings is based on the principle of source-pathway-receptor, as shown in Figure 1. This is a departure from previous approaches, in that more emphasis is given to addressing the impacts or consequences experienced by the receptors (people, buildings and infrastructure), rather than simply the actual hazard posed by a severe flood.
Avoidance and resistance measures, such as permanent or temporary defenses or landscaping, may be used along the 'pathway' to prevent floodwaters reaching a property.
Resistance and resilience measures may be used at the 'receptor' stage, on or within a property, which addresses both the probability and consequence of flooding.

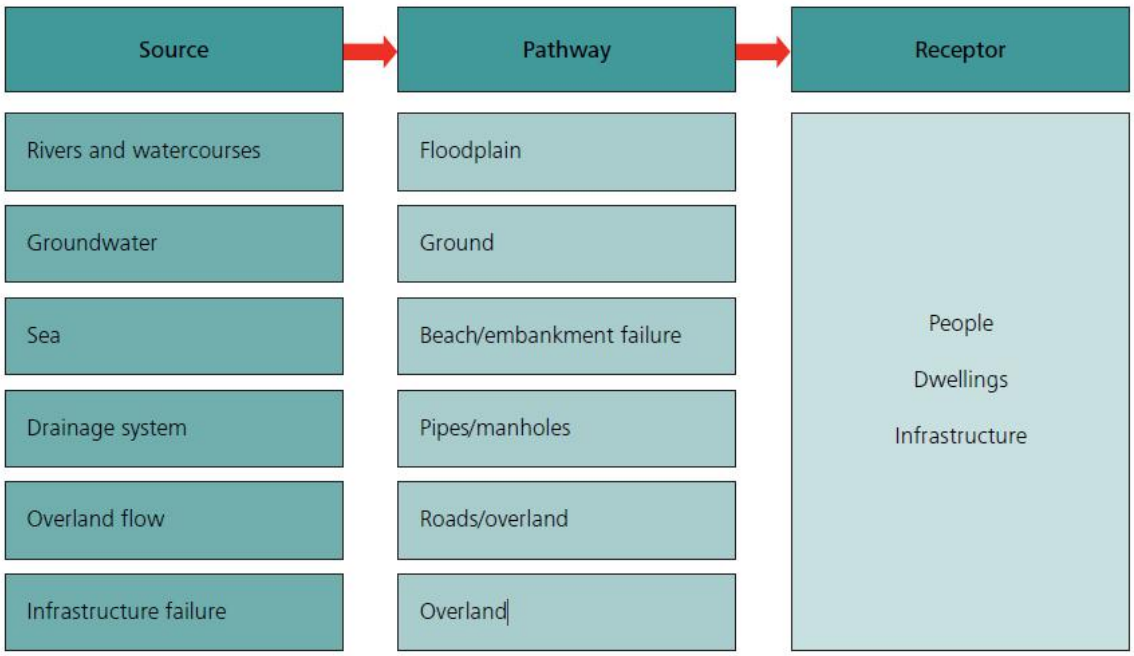


Figure 1; Flood risk management; the pathway of source-pathway receptor

Although flooding can result from a single event, it more commonly occurs through a combination of events:

- rainfall fills rivers, streams and ditches beyond their capacity. Floodwater overflows riverbanks

and flood defenses.

- coastal storms can lead to overtopping and breaching of coastal flood defenses. Properties built behind these defenses are therefore still at risk from flooding, although the 'residual' risk is lower. However, the consequences of this type of flood could be high.

- blocked or overloaded drainage ditches, drains and sewers may overflow across roads, gardens and into property

- overloaded sewers can sometimes back up into properties when they become blocked or too full

- rainfall can be so intense that it is unable to soak into the ground or enter drainage systems. Instead the water flows overland, down hills and slopes. Property at the bottom of hills or in low spots may be vulnerable. In urban areas floodwater may become contaminated with domestic sewage

- prolonged, heavy rainfall soaks into the ground and can cause the ground to saturate. This results in rising groundwater levels which leads to flooding above the ground. Floodwater may enter properties through basements or at ground floor level. Groundwater flooding may take weeks or months to dissipate

- a reservoir or canal may cause flooding either from overtopping or bank failure. This type of flooding (infrastructure failure) can result in rapidly flowing, deep water that can cause significant damage or loss of life.

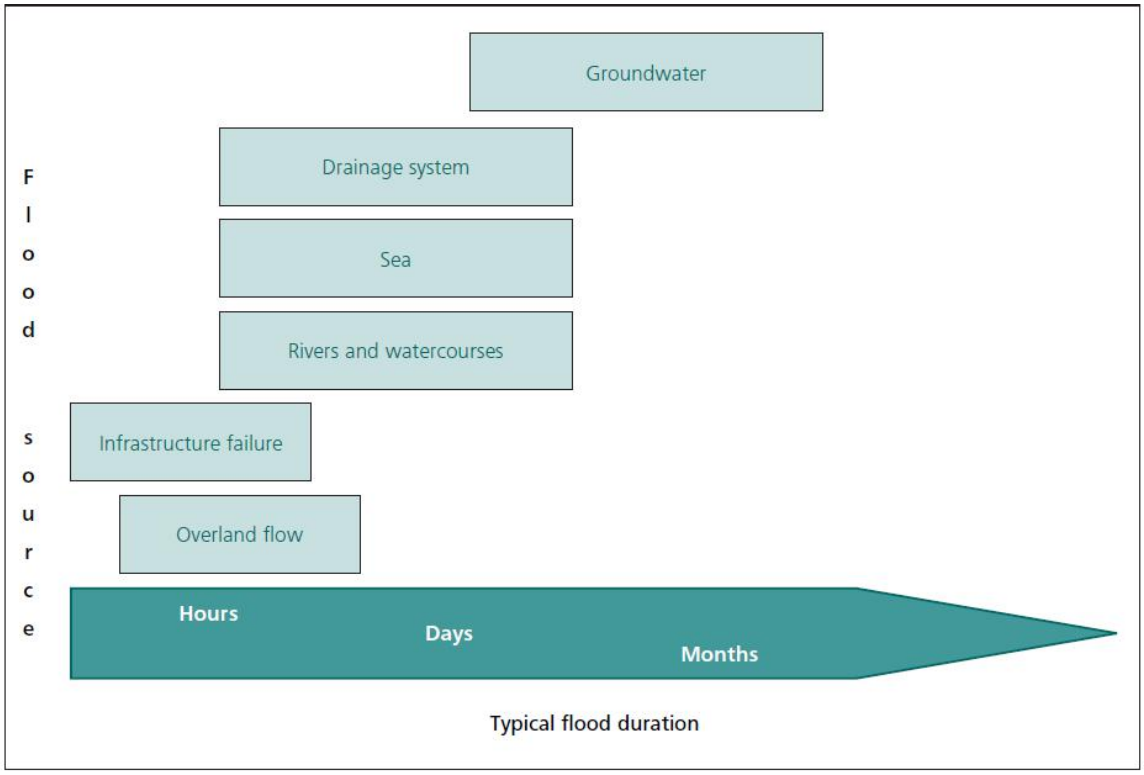


Figure 2: Provides typical durations for different types of flood. This is the length of time that the impact would be experienced by any receptors.

3.1.2 What is flood risk management?

All floods can be assessed in terms of flood depth, speed of flow, frequency of occurrence and duration (however, not all of these data are always readily available). This information can then be used to evaluate the flood risk to people and property at a particular location. Flood risk is a combination of the probability of the flood occurring and the consequence of the flood on people, property and infrastructure.

Knowing the characteristics of a particular flood is essential when designing a building to be resilient or resistant to flooding as it enables selection of the most appropriate form of mitigation measures. For example, groundwater flooding can be prolonged, and therefore appropriate basement (e.g. CIRIA, 1995) and floor construction design is critical. Living accommodation below ground level is not recommended for new build in flood risk areas.

It is possible to reduce the consequences of flooding to people and property by managing the flood risk. Flood risk should be managed in a hierarchical approach, by firstly considering developing outside flood risk areas (avoidance), secondly the use of resistance measures to prevent water

from entering a building, through to use of resilient measures to reduce the impact of flood damage to a building.

The best approach to flood risk management is avoidance. Ideally this would mean building outside of areas known to flood (or likely to flood). If this is not possible it can be achieved by, building above the flood level or preventing floodwater from reaching a building by site layout.

There can be local permanent resistance measures such as low walls or mounds around development sites, contouring of the site to divert floodwater away from buildings, or sealed gates. These measures are often associated with pumps to deal with rainwater and any small amounts of water that manage to circumvent the defenses. Flood barriers must be designed to withstand different water pressures, depending on the predicted depth of floodwater, and potential damage caused by floating debris.

Temporary building-level flood defense measures, such as installing flood boards on doorways or covers on service ducts, which can increase the flood resistance of a building, are however not a good solution for new buildings. It is preferable to design-in permanent flood resistance measures (such as low bunds around the development or building curtilage) than to rely on temporary solutions that require action by occupants to install, store and maintain them.

It is always preferable to keep floodwater out of buildings, but it is not always possible. Water can enter through the junctions of components of construction materials, as well as cracks and joints, and service ducts. Even then, if the water depth is higher on the outside than on the inside of a masonry building (and possibly other types) by about 0.6m there is the possibility that water pressure will cause the structure to collapse (USACE, 1988). The difference in level is called 'differential head, dH'. Figure 3 illustrate these concepts.

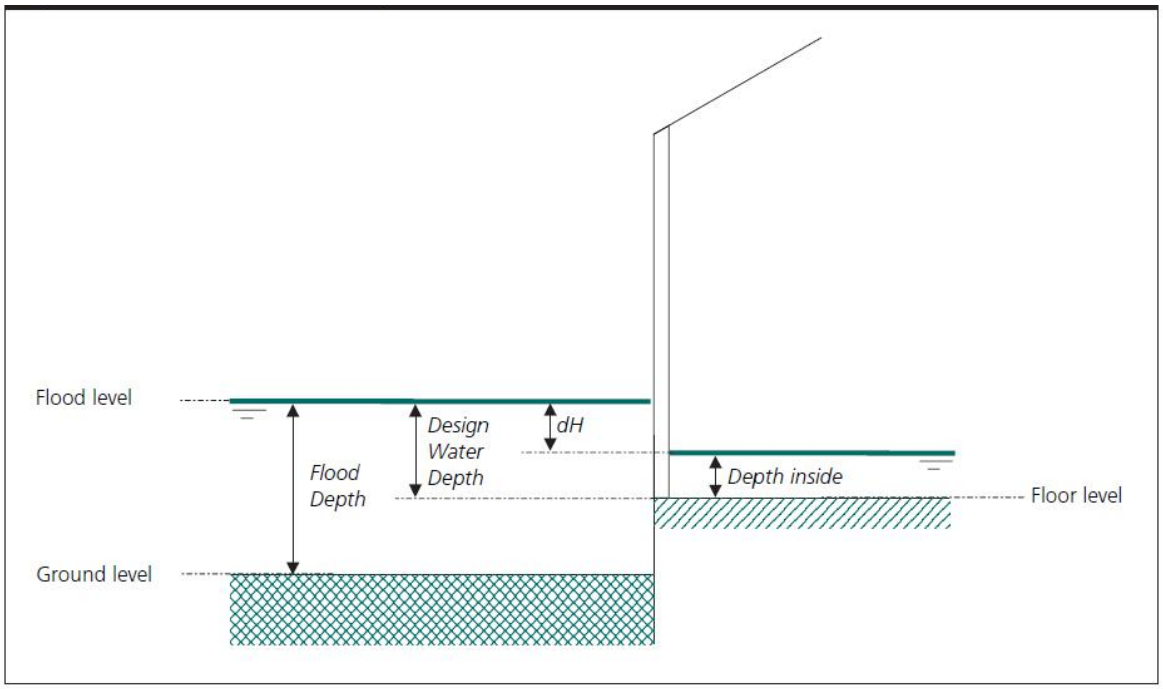


Figure 3; Definitions of flood depths

It is possible, using resilience measures as integral components of the building and/or inside the building, to reduce the risk of flood damage by careful selection of building materials, construction techniques and internal finishes. The use of appropriate resilience measures can also speed up recovery and repairs.

Resilience measures on their own are not suitable for areas with potential combined risk of high flood discharge rates, rapid rising levels and/or where speed of flow is likely to be high and dangerous to the stability of buildings and the safety of people. Speed of flow is one of the characteristics that should be considered in the preparation of the FRA.

Another aspect of flood risk management is the provision of flood warnings. Designs for effective flood warning systems should also be included in the FRA, to allow occupiers sufficient time to remove or relocate valuables and evacuate.

Flood risk to people and property can be managed and reduced but it can never be completely removed (Defra, 2005). There will always be a residual risk even after flood management schemes or measures to reduce flooding have been put in place and even in apparently safe sites, for example behind flood defenses.

Residual flood risk can be due to:

- failure of flood management infrastructure such as a breach of a raised flood defense, blockage of a surface water sewer or failure of a pumped drainage system
- a severe flood which causes a flood defense to be overtopped
- floods outside the known flood risk areas.

3.1.3 How does floodwater enter a building?

Floodwater will always follow a path of least resistance and will enter a building at the weakest points in the construction, particularly through masonry and construction joints, and any voids and gaps. The following summarizes the main entry points.

Current building regulations and traditional construction do not require the use of materials and design details that can withstand long-term immersion in flood water. Water could enter via:

- brickwork and blockwork
- party walls of terraced or semi-detached buildings if the attached building is flooded.
- expansion joints between walls where different construction materials meet or between the floor slab and wall.
- suspended timber ground floors via the interface between timber and mortar for built-in joists or along the interface between timber and metal plate where a joist hanger is used. Water will be absorbed through the exposed end grain of a built-in timber joist.

Specific features encourage air flow and therefore may provide a pathway for water. Routes include:

- vents, airbricks

Cracks and openings due to settlement, poor construction, and services all provide water entry routes, such as:

- cracks in external walls
- flaws in wall construction
- cracks and gaps at the interface between brick, stone and block units and their bedding mortar due to inadequate bonding. These can be as a result of movement caused by thermal expansion/contraction, moisture or settlement
- damp proof course (d.p.c.), where the lap between the wall damp proof course and floor membrane is inadequate
- services entries e.g. utility pipes, ventilation ducts, electricity and telephone cables
- gaps in mortar in masonry, stonework and blockwork walls, usually at perpends.

Other entry routes include:

- seepage from below ground through floors and basements
- sanitary appliances from backflow from surcharged drainage systems.
- inadequate seals between windows, doors and frames
- door thresholds

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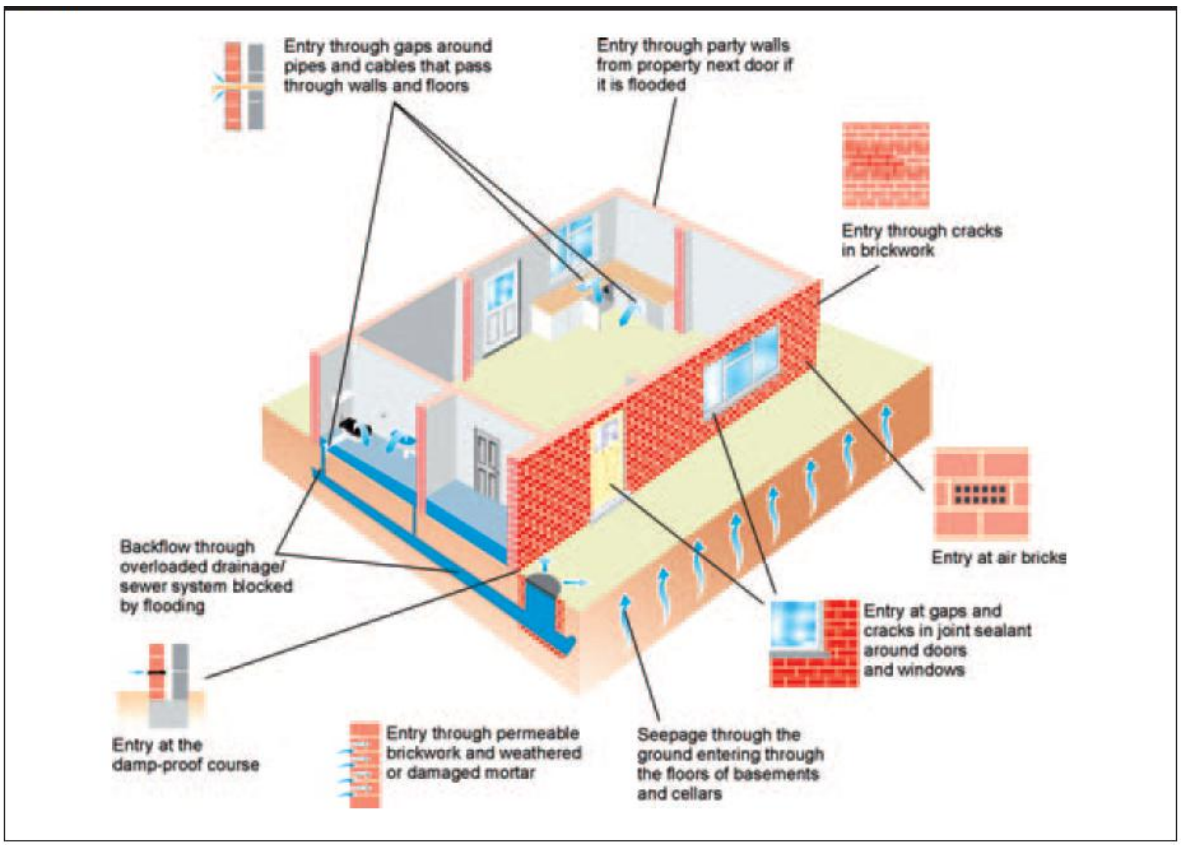

Figure 4: shows where floodwater can potentially enter a building

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3.1.4 What damage can a flood cause?

As well as having the potential to cause damage to the structure of a building, floodwater can also significantly impact the lives of the occupants. Fast flowing water or weakened structures could cause injury or even death. Physical health may suffer if floodwater is contaminated or if the building is re-occupied before it is allowed to dry effectively. Stress caused by the disruption to lifestyle and livelihood both during and after a flood is probably one of the main consequences of a flood.

This guidance does not cover the requirements for protection against structural damage caused by the weight and uplift forces due to the floodwater, nor impacts from water-borne debris. However, a summary of the likely damage to property caused by floodwater at different depths and heights is provided in Table 11 for information. It is important that a structural assessment of the risks posed by flood water is considered by an experienced professional during the building design phase.

Table 11: Possible flood damage for a typical residential property

Depth of floodwater	Damage to the building	Damage to services and fittings
Below ground floor level	Possible erosion beneath foundations, causing instability and settlement Possible corrosion in metal components (e.g. joist hangers) Excessive moisture absorption in timber, causing warping Cracking of ground floor due to uplift pressures Accumulation of contaminated silt Structural and material weaknesses from inappropriate drying Rot and mould	Damage to electrical sockets and other services in basements and cellars. Damage to fittings in basements and cellars
Ground level to half a metre above floor level	Build-up of water and silt in cavity walls, with potential reduction in insulating properties, for some materials Immersed floor insulation may tend to float and cause screeds to debond Damage to internal finishes, such as wall coverings and plaster linings Floors and walls may be affected to varying degrees (e.g. swelling) and may require cleaning and drying out Timber-based materials likely to require replacement Damage to internal and external doors and skirting boards Corrosion of metal fixings Rot and mould	Damage to water, electricity and gas meters Damage to low-level boilers and some underfloor heating systems Damage to communication wiring and services Carpets and floor coverings may need to be replaced Timber-based kitchen units are likely to require replacement Electrical appliances may need to be replaced Insulation on pipework may need replacing
Half a metre and above	Increased damage to walls (as above) Differential heads of greater than 0.6m across walls could cause structural damage, although this will vary depending on the structure of the building. Damage to windows can be caused by much smaller differential pressures High speed flow around the building perimeter can lead to erosion of the ground surface; there is also the potential risk of damage to the structure from large items of floating debris, e.g. tree trunks	Damage to higher units, electrical services and appliances

3.1.5 The effects of contaminated floodwater on buildings

Most floodwaters carry contaminants, such as sewage, hydrocarbons, silt, salt and other biological and chemical substances, which can affect the health of the occupants and the performance of the building. Buildings may require further cleaning or extended drying times following a flood leading to increased costs and delays in re-occupation.

There is very little evidence of buildings being designed to deal with contaminated floodwater. However, an effective way of dealing with contamination is to use materials that minimize adsorption, ensure effective drying can be achieved (by providing access to all spaces to permit drying), and ensure units/fittings etc. can be easily cleaned.

3.2 Design approaches and flood resilient design and construction.

Aligned with a systematic planning approach, various construction measures can be implemented to mitigate the risk of flooding at a site:

1. Flood avoidance: This involves constructing buildings and their surroundings in a manner that prevents them from being flooded. Examples include elevating structures above flood level or relocating them outside flood-prone areas.

2. Flood resistance: This measure focuses on constructing buildings to withstand floodwater and prevent its entry, thereby protecting the building's structure and interior from damage.

3. Flood resilience: Buildings constructed with flood resilience in mind can withstand the entry of floodwater while minimizing its impact. These structures are designed to incur no permanent damage, maintain structural integrity, and facilitate drying and cleaning processes after flooding.

4. Flood repairability: Structures built with flood repairability in mind allow for easy repair or replacement of elements damaged by floodwater. This approach enhances resilience by ensuring that the building can be quickly restored to its pre-flood condition.

In the realm of flood-resilient design and construction, this annex provides designers with valuable insights derived from laboratory tests, technical evidence, and industry expertise. It serves as a guide for determining the most suitable design strategy for flood management at the building site level, leveraging fundamental flood parameters such as depth, frequency, and duration. Typically, these parameters are identified during the initial flood risk assessment conducted during the planning stage.

Upon assessing these parameters, particularly flood depth, designers can opt for one of two overarching strategies: water exclusion or water entry. The decision between these strategies hinges on the specific characteristics of the flood scenario and the site conditions. The figure below illustrates these strategies and their potential applications:

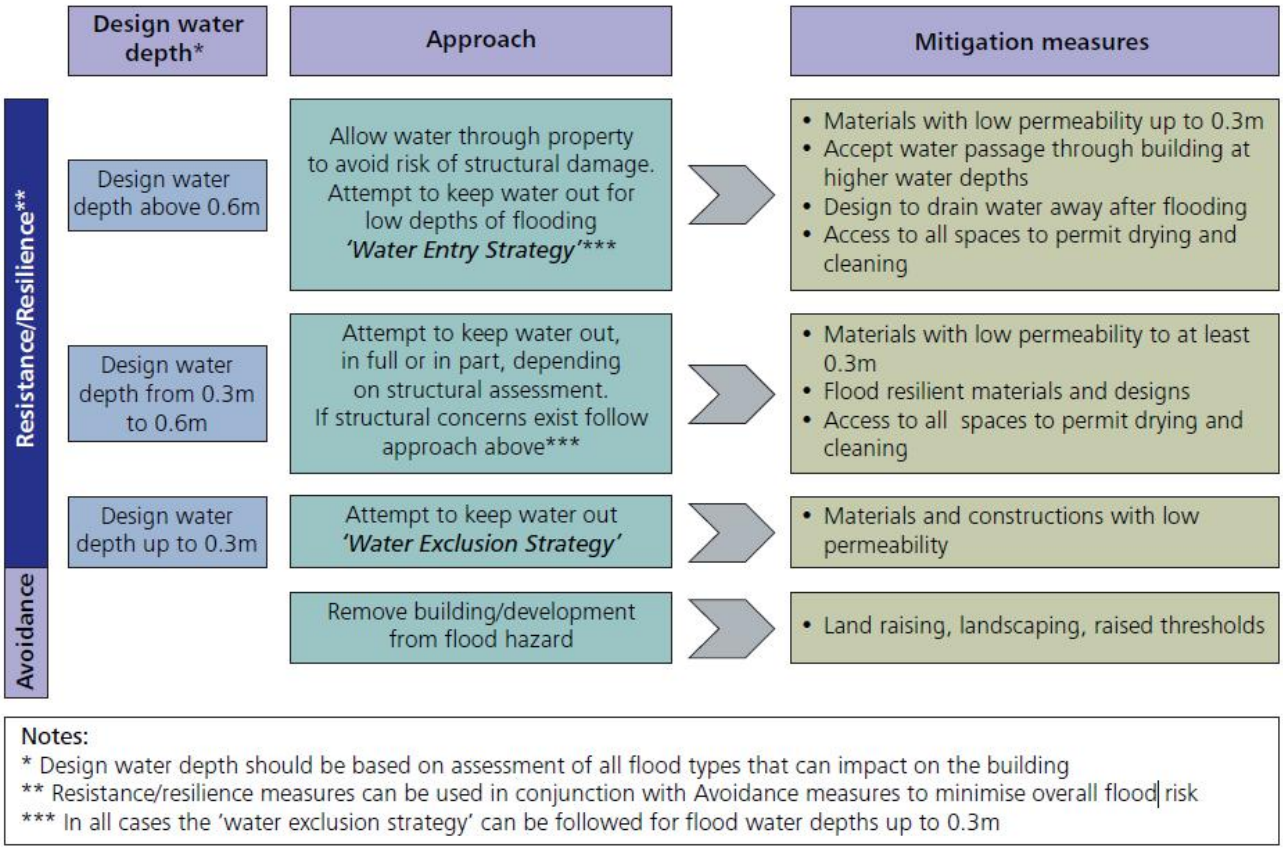


Figure 5 Rationale for design strategies

RESISTANCE / RESILIENCE measures include

- In a water exclusion strategy, emphasis is placed on minimizing water entry whilst maintaining structural integrity, and on using materials and construction techniques to facilitate drying and cleaning. This strategy is favored when low flood water depths are involved (up to a possible maximum of 0.6m). According to the definitions adopted in this Guidance, this strategy can be considered as a resistance measure but it is part of the aim to achieve overall building resilience.

- In a water entry strategy, emphasis is placed on allowing water into the building, facilitating draining and consequent drying. Standard masonry buildings are at significant risk of structural damage if there is a water level difference between outside and inside of about 0.6m or more. This strategy is therefore favored when high flood water depths are involved (greater than 0.6m).

Resilience measures are either an integral part of the building fabric or are features inside a building. These can be considered in combination with resistance measures or where resistance measures are not an option.

In order to decide which resilience measures would be effective it is necessary to know the potential depth and duration of flooding that is likely to occur. For the purpose of producing a simple design strategy, guidance on resilience measures is applicable to flood depths outside of a building of:

- less than 0.3m
- above 0.3m but less than 0.6m
- above 0.6m.

AVOIDANCE measures include:

- Not building in flood risk areas wherever possible!
- Raising ground or floor level or re-designing to a location outside the flood area, and provision of replacement storage.
- Local bunds can be designed to protect individual or groups of buildings from flooding. It is unlikely that these can be made fully watertight and pumps may be necessary to remove or re-direct any seepage water within the protected area. Bunds may be effective where the predicted duration and depth of flooding is low. Advice should be sought from a Qualified Engineer/Professional to ensure the bunds can withstand predicted water pressures.
- Landscaping of a development site or building curtilage to direct or divert floodwater away from buildings can be effective particularly where the predicted duration of flooding is short i.e. hours rather than days. Landscaping is an integral component of sustainable drainage systems (SUDS). They can be designed to manage flood risk and water quality, and also environmentally acceptable to communities.
- Boundary walls and fencing could be designed with high water resistance materials and/or effective seals to minimize water penetration for low depth, short duration floods (but not for groundwater flooding).

Figure 6 **Design strategies; decision flowchart – Avoidance (1)**

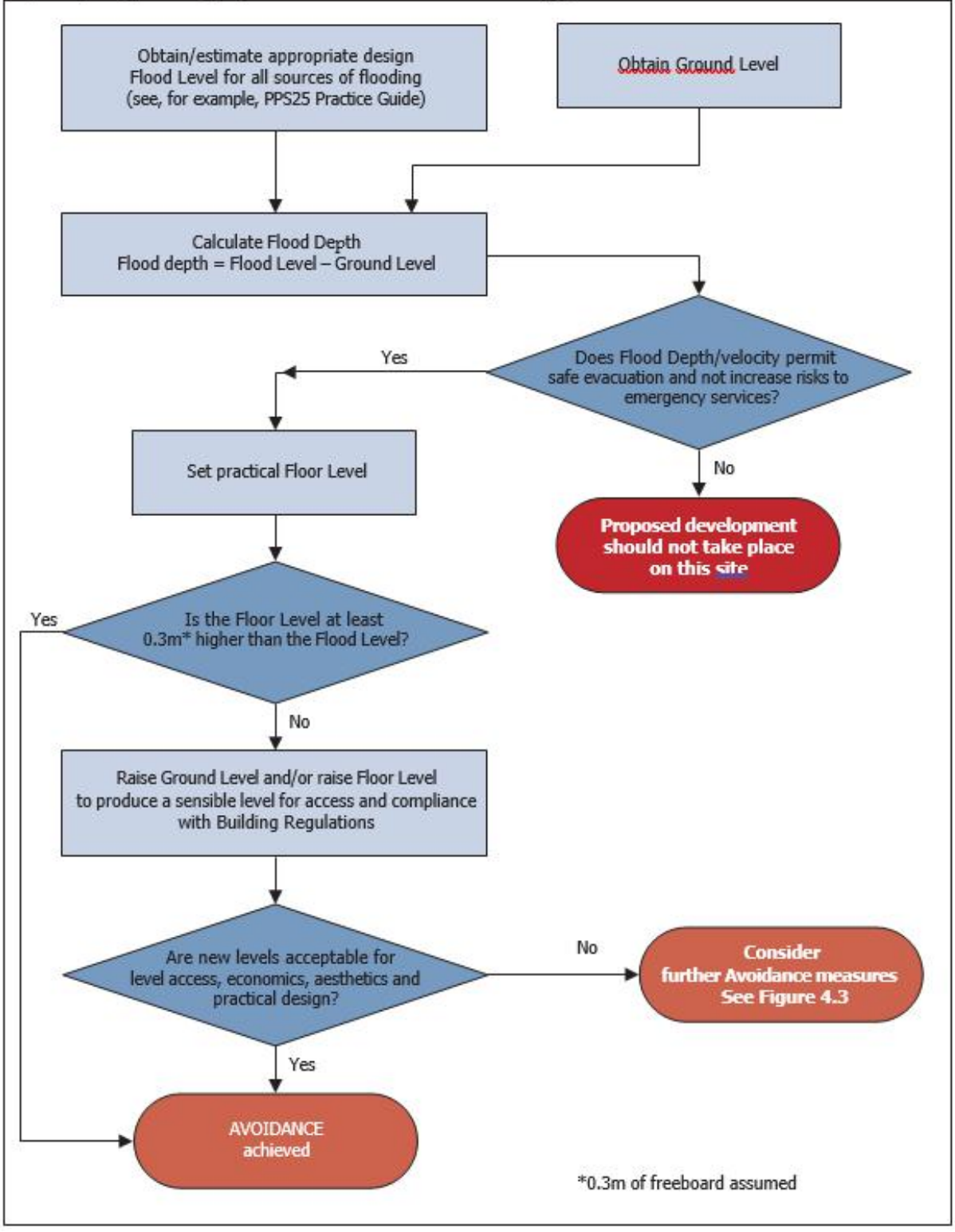


Figure 7 **Design strategies; decision flowchart – Avoidance (2)**

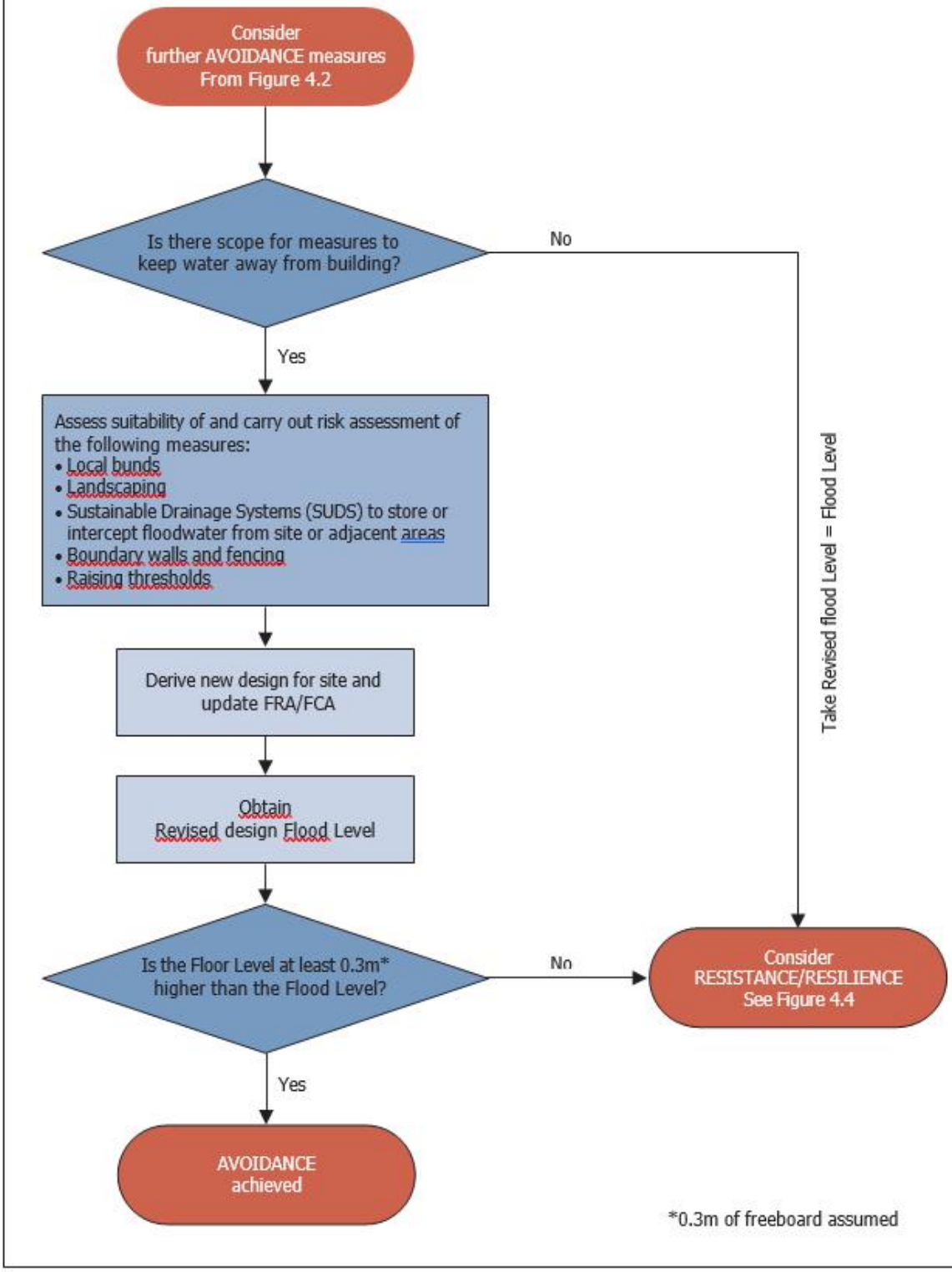
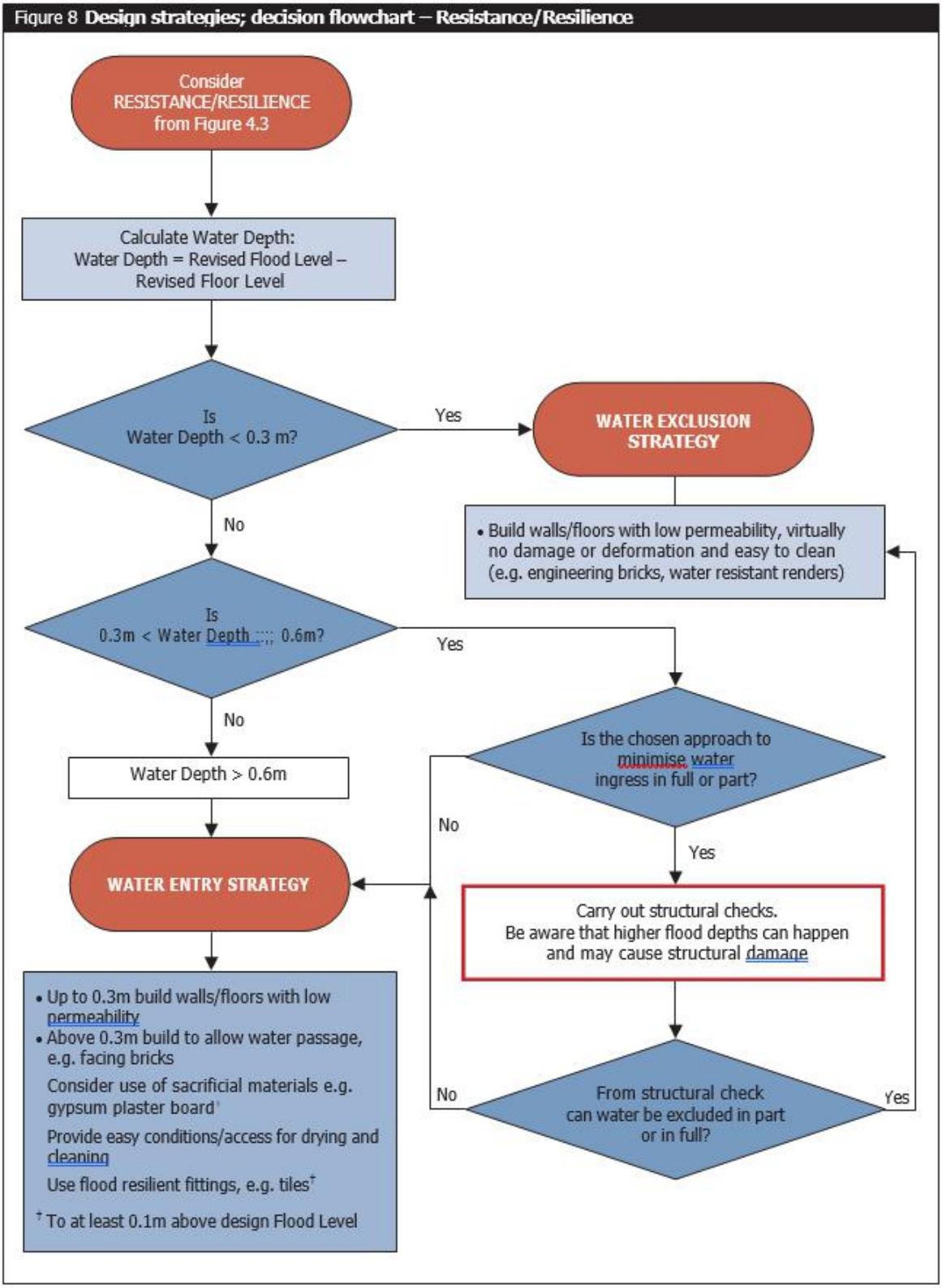


Figure 8 **Design strategies; decision flowchart – Resistance/Resilience**



3.3 Avoidance and resistance design options

This chapter considers in more detail the measures that can be adopted for avoidance and resistance, on site and at building level;

3.3.1 Avoidance

An essential strategy for mitigating the impacts of floods is to adopt a thoughtful development layout that reduces reliance on resistance and resilience measures. When planning the layout of a development, careful consideration should be given to facilitating safe movement of people within the area, particularly in proximity to potential water flow zones. It becomes crucial to identify overland flow routes and then devise strategies either to divert floodwater away from properties or to opt for alternative construction sites.

Moreover, existing drainage channels must undergo thorough assessment to gauge the probability of overflowing. This assessment helps in determining whether additional measures, such as reinforcing existing channels or creating new drainage pathways, are necessary to effectively manage flood risks.

Landscaping

Enhancing landscaping around individual or clusters of buildings to facilitate drainage away from properties can be a highly effective flood mitigation measure. In certain areas, it may even be feasible to adjust the contours of land at the peripheries of flood plains to accommodate new development without exacerbating flood risks. This can be achieved through flood plain compensation works integrated into the development process. For detailed guidance on landscaping, refer to CIRIA (2006a).

In some cases, a traditional and cost-effective approach involves constructing low-cost earth bunds to create localized flood defenses around sites or building perimeters, subject to approval from the planning authority. However, it's essential to consider the provision of pumping systems to manage potential rainwater or floodwater seepage effectively. Prior to implementation, a thorough assessment during the design phase is imperative to ensure that the construction of any earth bunds does not inadvertently increase flood risks in other areas.

Boundary walls and fencing

Boundary walls and fencing play a critical role in creating flood-resistant barriers around properties. Various design options can enhance their effectiveness in mitigating flood risks:

1. Solid gates equipped with discreet waterproof seals, along with integral drains where feasible, can effectively prevent floodwater ingress. These features help to seal off entry points vulnerable to flooding.

2. Fencing designs can incorporate lower elements constructed to withstand flooding more effectively. This approach strengthens the flood resilience of the fencing, reducing the risk of floodwater infiltration.

These flood-resistant features, such as gates and fencing, are commonly utilized by sewerage undertakers to address low-depth flooding issues originating from sewers. Implementing such design measures can significantly enhance the flood resilience of properties and minimize potential flood damage.

Fig 9 Flood protection with boundary wall and draining

Fig 10; Example of property boundary wall and lower sealed gate

Figure 11: Example of sealed gate

Figure 12 Example of protection of fence base with impermeable material

3.3.2 Resistance

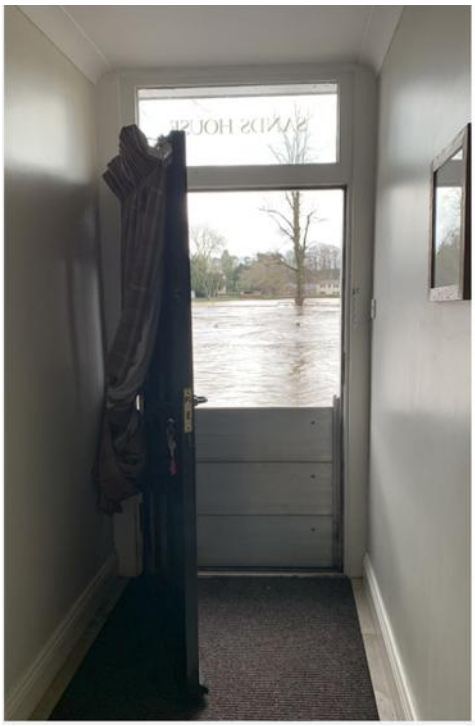
A flood 'resistance' approach aims to prevent water entry or reduce the amount of floodwater that enters a property and it requires the purchase and installation of home flood defense products or flood barriers. These products can be permanent or temporary. Permanent products are fitted, left in place, and remain 'always ready' to work 24/7, with no action needed to activate them in the event of a flood. Temporary measures are usually stored away and then put in place when flooding is expected. See pictures fig 13 up to 17 and https://aquobex.com/products-list/floodguard-clip-in-barrier/

Figure 13; Flood barrier

Figure 14; Flood barrier for door

When constructing new properties, permanent flood resistance measures (e.g. use of low permeability materials) are always preferable to temporary measures, such as flood resistance products (e.g. door flood guards) as they do not require intervention by the property occupants. Materials providing resistance to water ingress are evaluated further.

Figure 15; Flexible mobile flood barrier



3.4 Flood resilient design and construction.

3.4.1 General principles

This chapter provides technical guidance on building materials and forms of construction (and to a lesser extent, on fittings) that are appropriate for improving the flood resilience of buildings.

Any resilience measures should be designed so that the building can be occupied safely over its proposed lifetime taking climate change into account.

It is generally accepted that total prevention of water ingress or 'dry proofing' to a building is very difficult to achieve. The strategies that are recommended to minimize flood impact to buildings and their occupants are described in

In terms of achieving resilience, there are two main strategies, whose applicability is dependent on the water depth the property is subjected to.

- Water exclusion strategy – where emphasis is placed on minimizing water entry whilst maintaining structural integrity, and on using materials and construction techniques to facilitate drying and cleaning. This strategy is favored when low flood water depths are involved

(not more than 0.3m). According to the definitions adopted in this Guidance, this strategy can be considered as a resistance measure but it is part of the aim to achieve overall building resilience

- Water entry strategy – where emphasis is placed on allowing water into the building, facilitating draining and consequent drying. Standard masonry buildings are at significant risk of structural damage if there is a water level difference between outside and inside of about 0.6m or more. This strategy is therefore favored when high flood water depths are involved (greater than 0.6m).

3.4.2 Building materials

It should also be noted that there is variability within materials that may affect their resilience performance. As expected, the denser materials such as concrete and engineering bricks were found to have good resilience characteristics. In general, the findings of the materials testing confirmed existing knowledge and experience but provided new quantitative data on construction material behavior.

Table 12 presents the characteristics of common building materials, tested in the laboratory, classified as having good, medium or poor performance with regard to water penetration, drying ability and integrity.

Definitions of the characteristics used in Table 12 are:

- water penetration – the seepage (rate and volume) through the material (note that this is different from “water absorption”)
- drying ability – the capability to regain its original moisture condition (assessed by the average drying rate and the time taken to reach the original value)
- retention of pre-flood dimensions, integrity – the lack of deformation or change in form or appearance of the material.

Material	Resilience characteristics*		
	Water penetration	Drying ability	Retention of pre-flood dimensions, integrity
Bricks			
Engineering bricks (Classes A and B)	Good	Good	Good
Facing bricks (pressed)	Medium	Medium	Good
Facing bricks (handmade)	Poor	Poor	Poor
Blocks			
Concrete (3.5N, 7N)	Poor	Medium	Good
Aircrete	Medium	Poor	Good

Timber board			
OSB2, 11mm thick	Medium	Poor	Poor
OSB3, 18mm thick	Medium	Poor	Poor
Gypsum plasterboard			
Gypsum Plasterboard, 9mm thick	Poor	Not assessed	Poor
Mortars			
Below d.p.c. 1:3(cement:sand)	Good	Good	Good
Above d.p.c. 1:6(cement:sand)	Good	Good	Good
* Resilience characteristics are related to the testing carried out and exclude aspects such as ability to withstand freeze/thaw cycles, cleanability and mould growth			

Table 12 Flood resilience characteristics of building materials (based on laboratory testing)

3.4.3 Foundations

Foundations are designed to suit site conditions, namely the local geotechnical characteristics and the building design. Strip and trench-fill foundations are generally used where no special problems are identified, whereas raft, pile, pier and beam foundations may be necessary in other cases. In general, the choice of foundation type will be dictated by ground conditions, rather than resilience considerations. However, improvements can be made to increase the resilience.

For typical two-storey dwellings shallow footings are likely to be appropriate in most cases. It is common practice to use concrete blocks as substructure elements in typical cavity wall buildings but laboratory work has shown that groundwater can penetrate through the blocks into the wall cavity (and from there into the building) if care is not taken to minimize the passage of water. There is a general recommendation in the NHBC Standards, 2006) to allow a clear cavity of at least 225mm below damp proof course (d.p.c.) to prevent the buildup of any mortar dropped during construction from having a detrimental effect on the performance of the wall. However, this unsealed void may be an entry point for rising ground water into the property via the blockwork.

3.4.3.1 Water exclusion strategy

A general principle for flood resilient design where predicted flood water depths are relatively small (no greater than 0.3m above floor level) is to minimize the entry of water through permeable elements of the foundation. Any concrete blocks placed below ground-bearing concrete floor slabs provide a potential path for water to ingress into wall cavities, as these blocks are considerably more permeable than concrete slabs. Figures 16. and 17, illustrating a ground bearing slab and a concrete suspended floor slab, show a potential flow path from the ground adjacent and under a dwelling, through porous substructure and into the wall cavity. The use of concrete or another impermeable material to seal the blocks may resolve this problem.

The figures highlight the fact that measures taken above ground level may not fully prevent the ingress of water.

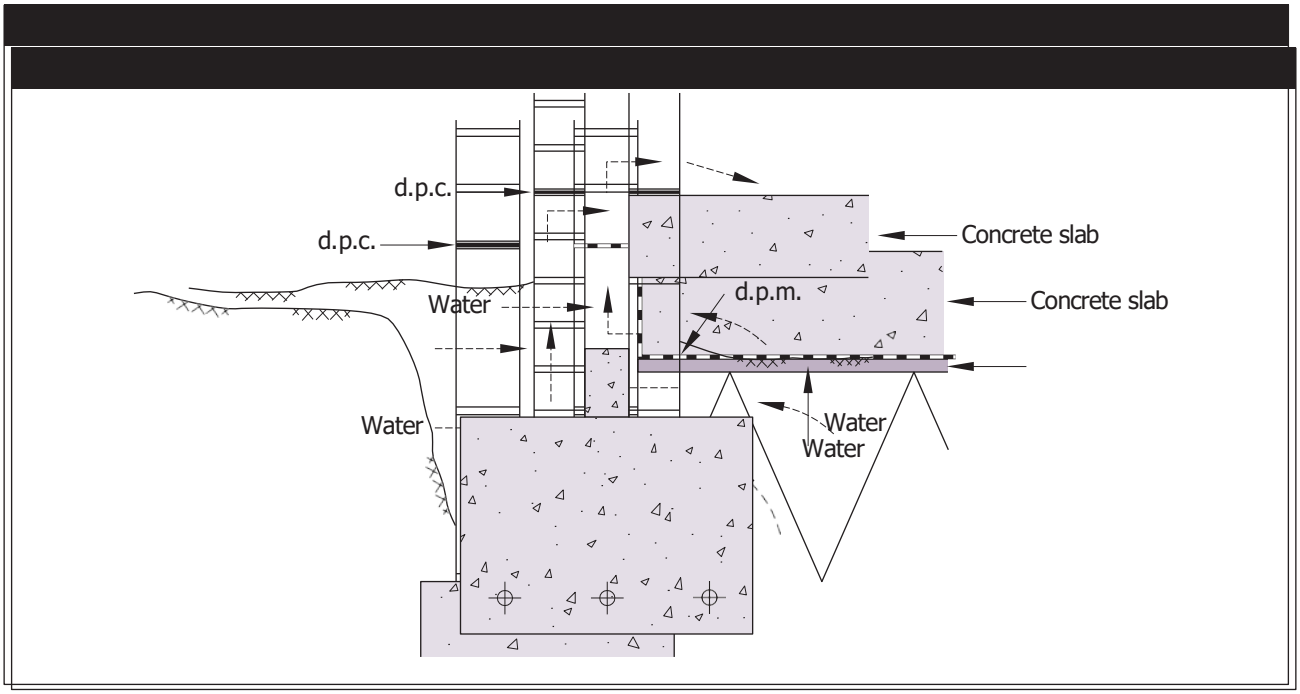


Figure 17 Water ingress into properties through the ground – suspended floor

General advice for resilient design

Where concrete ground floor slabs are used, the blockwork substructure is often the weakest point in terms of water penetration from the ground into a dwelling. Whereas there is a general perception that water can ingress through the blockwork structure of the external face of a wall into the property, it is less apparent, but equally possible, that water will penetrate from the ground on the inside of the property. Figures 16 and 17 illustrate these flow paths for two types of ground floor (ground bearing floor and suspended concrete floor), and different types of foundation (typical for construction in England).

Concrete blocks used in foundations should be sealed with an impermeable material or encased in concrete to prevent water movement from the ground to the wall construction.

3.4.3.2 Water entry strategy

General advice for resilient design

A general principle for flood resilient design where predicted flood water depths are high is to provide durable materials that will not be affected by water and use construction methods and materials that promote easy draining and drying.

Standard methods and good quality building materials will generally comply with these requirements but good workmanship is essential.

3.4.4 Floors

The behavior of ground floors in floods can be influenced by two different conditions:

- water ingress from the ground (potentially resulting in uplift pressures), and
- exposure to standing water

Of the above two situations (which can occur simultaneously), water ingress from the ground is potentially more severe as it is more likely to affect the structural integrity of the floor. Structural calculations may need to be carried out to ensure that the floor (including any lateral support provided at the perimeter) has the necessary strength to resist uplift forces without excessive deformation or cracking.

3.4.4.1 Water exclusion strategy

When applying a "water exclusion strategy" (i.e. minimizing water ingress through ground floor slabs), for predicted water depths above the floor of greater than 0.3m, it is important to carry out structural checks assuming a flood depth of 1m minimum above the slab, even in areas where the design flood water depth is lower. Usual safety factors must be applied in all such calculations (floors and walls). Laboratory evidence on small slabs (0.5m by 0.5m) indicated that 150mm thick concrete slabs on supporting soil can withstand such forces without allowing water ingress. However, for larger slabs, uplift forces may cause deformation and induce cracking and lead to preferential paths for water ingress.

General advice for resilient design

Ground supported floors are the preferred option and concrete slabs of at least 150mm thickness should be specified for non-reinforced construction. Hollow slabs are not suitable if the elements are not effectively sealed.

Suspended floors may be necessary where ground supported floors are not suitable, namely in shrinkable/expanding soils (e.g. clay) or where the depth of fill is greater than 600mm. Uplift forces caused by flood water may affect the structural performance of a floor. Suspended floors are generally not recommended in flood-prone areas, for the following reasons:

– the sub-floor space may require cleaning out following a flood, particularly a sewer flood. In order to aid this process and where accumulation of polluted sediment is expected, the sub-floor space should slope to an identified area and be provided with suitable access

– if cleaning is required, floor finishes may need to be removed to provide access to the sub-floor space. Cheaper, sacrificial, finishes would be the best option.

– the steel reinforcement in the concrete beams of 'beam and block' floors may be affected by corrosion and its condition may need to be assessed following repeated or prolonged floods.

Suspended timber floors, particularly when including timber engineered joists, are not generally recommended in flood prone areas because most wooden materials tend to deform significantly when in contact with water and therefore may require replacement. Rapid drying can also cause deformation and cracking.

Reinforced concrete floors are acceptable but may be prone to corrosion of any exposed steel in areas of prolonged flooding.

Hardcore and blinding: good compaction is necessary to reduce the risk of settlement and consequential cracking.

Damp Proof Membranes (d.p.m.) should be included in any design to minimize the passage of water through ground floors. Impermeable polythene membranes should be at least 1200 gauge to minimize ripping. Effective methods of joining membrane sections are overlaps of 300mm, and also taping (mastic tape with an overlap of 50mm minimum). Care should be taken not to stretch the membrane in order to retain a waterproof layer. Experience in Scotland has indicated that welted joints in the d.p.m. are an effective jointing solution.

Insulation materials: Water will lower the insulation properties of some insulation materials. Floor insulation should be of the closed-cell type to minimize the impact of flood water. The location of insulation materials, whether above or below the floor slab, is usually based on either achieving rapid heating of the building or aiming for more even temperature distribution with reduced risk of condensation. Insulation placed above the floor slab (and underneath the floor finish) rather than below would minimize the effect of flood water on the insulation properties and be more easily replaced, if needed. However, water entry may cause insulation to float (if associated with low mass cover) and lead to deboning of screeds.

No firm guidance can be provided on best location for insulation where the primary source of flooding is from groundwater. For other types of flooding, placing insulation below the floor slab may be adequate but it is important to recognize that the characteristics of the insulation may be affected by the uplift forces generated by the flood water.

Floor finishes: suitable floor finishes include ceramic or concrete-based floor tiles, stone, and sand/cement screeds. All tiles should be bedded on a cement-based adhesive/bedding compound and water resistant grout should be used. Concrete screeds above polystyrene or polyurethane insulation should be avoided as they hinder drying of the insulation material. Suitable materials for skirting boards include ceramic tiles and PVC. Ceramic tiles are likely to be more economically viable and environmentally acceptable.

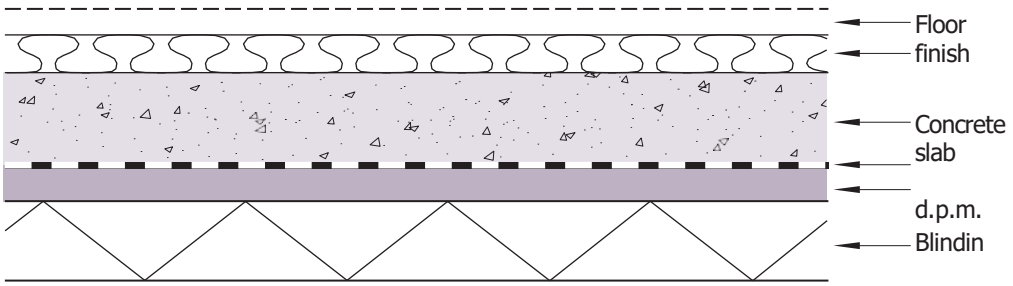
Floor sump: provision of a sump and small capacity automatic pump at a low point of the ground floor is recommended in cases where the expected probability of flooding in any one year is 20% or a frequency of flooding of more than once in five years (see Section 4). This system will help the draining process and speed up drying but it may only be effective for shallow depth flooding. The dimensions

of the sump and its operational procedure would be calculated and agreed with the planning authority based on the predicted volumes of water to be drained.

Services: under floor services using ferrous materials should be avoided

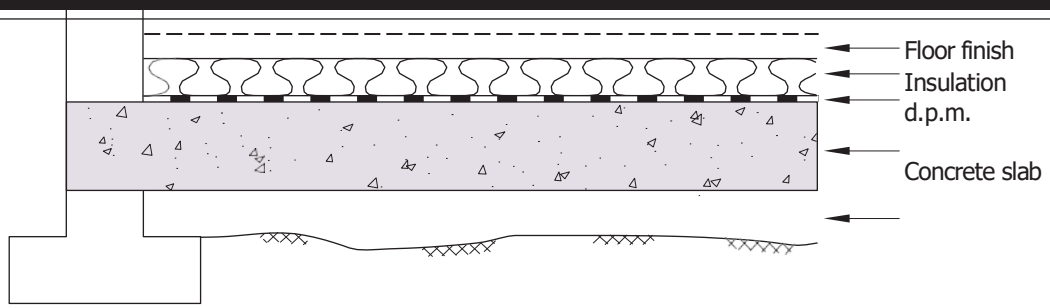
Recommended ground-supported and acceptable suspended floor arrangements are presented in Figures 6.4 to 6.6. If suspended timber flooring is a favored option, then a combination of construction elements that is likely to minimize problems associated with flooding is shown in Figure 6.6. This is referred to as a "Restricted option"

Figure 17 **Ground-supported floor – Preferred option**



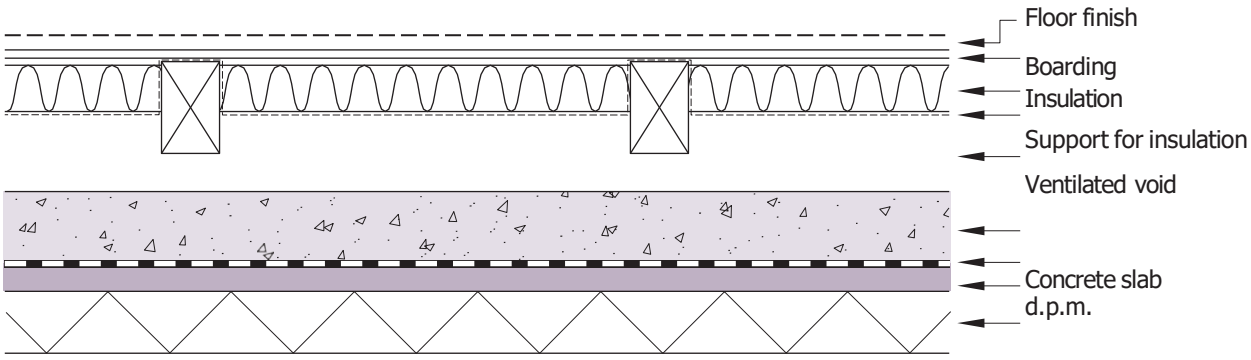
- Hardcore bed at least 100mm thick of well compacted inert material, blinded with fine inert material to provide a smooth base
- Damp proof membrane of polythene at least 1200 gauge
- Concrete slab at least 150mm thick
- Insulation as rigid closed-cell material

Figure 18 **Suspended Concrete Floor – Acceptable option**



- Reinforced concrete slab at least 150mm thick and complying with structural requirements for uplift forces
- Damp proof membrane of polythene at least 1200 gauge
- Insulation as rigid closed-cell material

Figure 19 Suspended **Timber Floor – Restricted option**



- Hardcore bed at least 100mm thick of well compacted inert material, blinded with fine inert material to provide a smooth base
- Concrete slab at least 150mm thick
- Insulation as rigid, closed cell material and supported with battens, plastic mesh or corrosion-resistant fixings
- Boarding consisting of WBP Plywood and preservative treated timber
- Stainless steel hangers

Figures 17 and 18 illustrate recommended floor designs for the water-entry strategy

3.4.4.2 Water entry strategy

General advice for resilient design

Materials that retain their integrity and properties when subjected to flood water (such as concrete) or those that can be easily replaced (sacrificial materials), should be specified. Construction should allow easy access for cleaning, (e.g. below suspended floors), and drainage.

Concrete ground-supported floors are the preferred option and concrete slabs of at least 100mm thickness should be specified.

Suspended floors may be necessary where ground-supported floors are not suitable, namely in shrinkable/expanding soils (e.g. clay soils) or where the depth of fill is greater than 600mm. In cases of prolonged floods, where flood water is heavily silted, or from sewer flooding, the sub-floor space may require cleaning out following a flood; to aid this process, it should slope to an identified low point and be provided with suitable access. If cleaning is required, floor finishes may need to be removed to provide access to the sub-floor space and therefore cheaper, sacrificial, finishes would be the best option. Alternatively, external access to the sub-floor space can be considered as a design option.

Suspended steel floors may be adequate provided they incorporate resilient features such as anti-corrosion properties and comply with required structural capability.

Suspended timber floors, particularly when including timber engineered joists, are not generally recommended in flood prone areas because most wooden materials tend to deform significantly when in contact with water and therefore may require replacement. Rapid drying can also cause deformation and cracking.

Hardcore and blinding: good compaction should be achieved to reduce the risk of settlement and consequential cracking.

Damp Proof Membranes (d.p.m.) should be included in any design to minimize the passage of water through ground floors. Impermeable polythene membranes should be at least 1200 gauge to minimize ripping. Effective methods of joining membrane sections are: overlaps of 300mm or taping with mastic tape with an overlap of 50mm minimum. Care should be taken not to stretch the membrane in order to retain a waterproof layer. Experience in Scotland has indicated that welted joints in the d.p.m. are an effective jointing solution but the quality of the welts is very dependent on workmanship.

Insulation materials: Water will lower the insulation properties of some insulation materials. Floor insulation should be of the closed-cell type to minimize the impact of flood water. The location of insulation materials, whether above or below the floor slab, is usually based on either achieving rapid heating of the building or aiming for more even temperature distribution with reduced risk of condensation. It is recommended that insulation be placed above the floor slab (and underneath the floor finish) rather than below would minimize the effect of flood water on the insulation properties and be more easily replaced, if needed.

Floor finishes: there are two possible approaches that depend on an assessment of the likely frequency of flooding and cost of material and installation: use of sacrificial materials or reliance on high quality durable materials – see Section 4. Sacrificial floor finishes can include timber flooring and soft furnishings such as carpets. Materials that are likely to withstand exposure to floodwater without significant deterioration are ceramic or concrete-based floor tiles, marble or stone. All tiles should be set on a bed of sand and cement render and water resistant grout should be used.

Concrete screeds above polystyrene or polyurethane insulation should be avoided as they hinder drying of the insulation material due to the relative impermeability.

Suitable materials for skirting boards include ceramic tiles and PVC. Ceramic tiles are likely to be more economically viable and environmentally acceptable. Replacement timber may be a suitable option, for cases where a strategy to use of sacrificial materials is adopted.

Floor sump: provision of a sump and small capacity pump in the floor at a low point of the ground floor is recommended in cases where the expected frequency of flooding is high; this system will help the draining process and speed up drying but it may only be effective for shallow depth flooding. The dimensions of the sump and its operational procedure would be calculated and agreed with the Planning Authority based on the predicted volumes of water to be drained.

Services: under floor services using ferrous materials should be avoided.

3.4.5 Walls

The recommendations given in this section on wall construction are based primarily on recent laboratory investigations, but are supported by expert opinion and experience from the building

industry – see Chapter 7. The laboratory tests covered 16 wall panels (approximately 1.1m high by 1m wide) of composite construction subjected to 1m head of water and then allowed to dry naturally. This is not an exhaustive list of constructions and other wall designs may also have adequate resilience characteristics.

Table 6.2, based on the laboratory evidence, classifies wall components as good, medium or poor with regard to water penetration, surface drying and structural integrity.

Definitions of the characteristics used in Table 13are:

- water penetration – the leakage (rate and volume) through the entire wall thickness (note that this is different from "water absorption")
- drying ability – the capability to regain its original surface moisture condition (assessed by the average drying rate and the time taken to reach the original value)
- retention of pre-flood dimensions, integrity – the lack of deformation or change in form or appearance of the wall panel.

Material	Resilience characteristics*		
	Water penetration	Drying Ability	Retention of pre-flood dimensions, integrity
External face			
Engineering bricks (Classes A and B)	Good	Good	Good
Facing bricks (pressed)	Medium	Medium	Good
Internal face			
Concrete blocks	Poor	Medium	Good
Aircrete	Medium	Poor	Good
Cavity insulation			
Mineral fibre	Poor	Poor	Poor
Blown-in expanded mica	Poor	Poor	Poor
Rigid PU foam	Medium	Medium	Good
Renders/Plaster			
Cement render – external	Good	Good	Good
Cement/lime render – external	Good	Good	Good
Gypsum Plasterboard	Poor	Not assessed	Poor
Lime plaster (young)	Poor	Not assessed	Poor
* Resilience characteristics are related to the testing carried out and exclude aspects such as ability to withstand freeze/thaw cycles, cleanability and mould growth			

Table 13: Flood resilience characteristics of walls (based on laboratory testing)

3.4.5.1 Water exclusion strategy

This strategy is applicable to design flood depths of up to 0.3m or up to 0.6m, if allowed by the structural assessment of the design.

General advice for resilient design

Ensure high quality workmanship at all stages of construction.

Masonry walls:

Ensure mortar joints are thoroughly filled to reduce the risk of water penetration. If frogged bricks are used, they should be laid frog up so that filling becomes easier and coverage more certain. Bricks manufactured with perforations should not be used for flood resilient design.

Where possible, use engineering bricks up to predicted flood level plus one course of bricks to provide freeboard (up to maximum of 0.6m depth above floor level); this will increase resistance to water penetration. Blocks (and dense facing bricks) have much improved performance when covered with render.

Air Crete blocks allow less leakage than typical concrete blocks but concrete blocks dry more quickly. Therefore, design of blockwork walls needs to take into account these two opposite types of behavior and consider whether drying or resistance to water is most relevant in each situation. For a “water exclusion strategy”, the expected amount of leakage is minimal and therefore, Air Crete blocks are recommended, although they may retain moisture for longer than concrete blocks, compared with heavier blocks, Air Crete may offer less restraint to floor/slab edges which under the action of uplift forces could promote the opening up of floor/wall junctions.

Do not use highly porous bricks such as handmade clay bricks.

Solid masonry walls are a good option but will need to be fitted with internal or external wall insulation in order to comply with Building Regulations Clear cavity walls, i.e. with no insulation in the cavity, have better flood resilience characteristics than filled or part filled cavity walls as they dry more quickly. The requirements for insulation can be satisfied by external insulated renders or internal thermal boards.

There is evidence that thin layer mortar construction (or thin joint, as it is also commonly known) is a good flood resilience option.

Framed walls: Avoid timber framed walls containing construction materials that have poor performance in floods, for example oriented strand board and mineral fiber insulation. Timber framed walls are not recommended in a “water exclusion strategy”. Steel framed walls may offer a suitable alternative option but specialist advice needs to be sought on how to incorporate resilient materials/construction methods in the design, in particular with regard to the insulation.

Reinforced concrete wall/floor construction should be considered for flood-prone areas, i.e. where the frequency of flooding is predicted to be high (see Chapter 4). This form of construction is effective at resisting forces generated by floodwater and will provide an adequate barrier to water ingress (provided service ducts and other openings into the building are

adequately sealed). Design details for this type of construction are beyond the scope of this document.

External renders are effective barriers to water penetration and should be used with blocks (or bricks) at least up to the predicted flood level plus the equivalent of a course of bricks as freeboard.

Structural checks may be necessary to ensure stability, because of the external water pressures that could occur for design flood depths above 0.3m. External cement renders with lime content (in addition to cement) can induce faster surface drying.

Insulation:

External insulation is better than cavity insulation because it is easily replaced if necessary.

Cavity insulation should preferably incorporate rigid closed cell materials as these retain integrity and have low moisture take-up. Other common types, such as mineral fiber batts, are not generally recommended as they can remain wet several months after exposure to flood water which slows down the wall drying process. Blown-in insulation can slump due to excessive moisture uptake, and some types can retain high levels of moisture for long periods of time (under natural drying conditions).

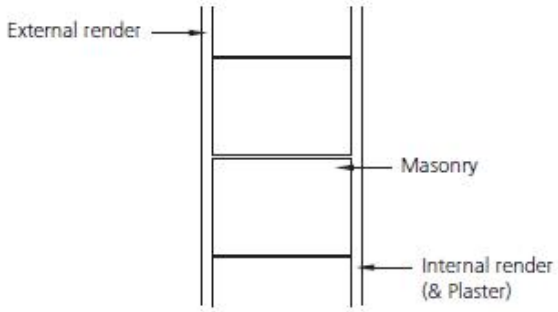
Internal linings:

Internal cement renders (with good bond) are effective at reducing flood water leakage into a building and assist rapid drying of the internal surface of the wall. The extent to which render prevents drying of other parts of the wall is not currently clear. This may be important, particularly for solid wall construction. This applies also to external renders.

Avoid standard gypsum plasterboard as it tends to disintegrate when immersed in water. Splash proof boards do not necessarily offer protection against flood waters, which may remain for some time and exert pressure on the board.

Examples of recommended wall arrangements are presented in Figures 21 to 24 below.

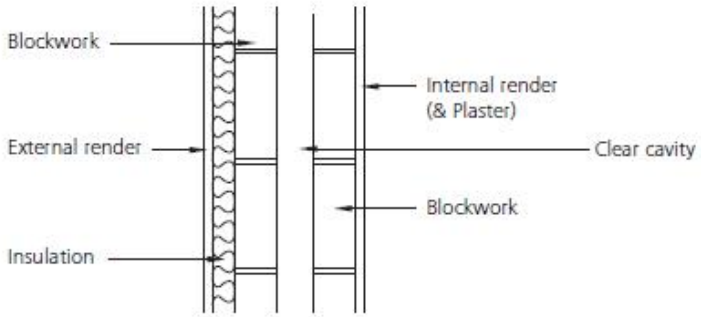
Figure 21 Solid External Walls



- External cement based render, preferably with lime content. Composition depends on masonry. The following mixes have good resilient properties:
  - 1 cement : 6 sand on bricks;
  - 1 cement : 4 sand: ½ lime on concrete blockwork or bricks;
  - 1 cement : 6 sand: 1 lime on Aircrete blocks.
- Masonry with minimum thickness of 300mm (thin mortar joint construction using Aircrete blocks is effective as demonstrated in laboratory tests) or alternatively reinforced concrete wall
- Internal cement-based render, preferably with lime content. Composition depends on masonry; the following mix is effective for flood resilience:
  - 1 cement : 6 sand: 1 lime on Aircrete.

  Apply external and internal renders, following good practice guidance, ensuring minimum total thickness of 20mm and at least two coats.
- Use external insulation in preference to internal insulation.

Figure 22 Cavity External Walls – Clear cavity

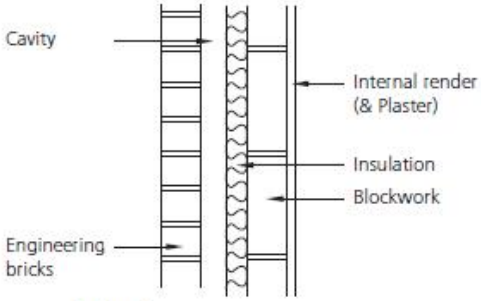


Clear cavity

- External cement based render, preferably with lime content. Composition depends on masonry; the following mixes are effective for flood resilience:
  - 1 cement: 4 sand: ½ lime on concrete blockwork (or bricks);
  - 1 cement: 6 sand: 1 lime on Aircrete.

  Apply render following good practice guidance, ensuring minimum total thickness of 20mm and two coats.
- Internal cement based render, preferably with lime content. Composition depends on masonry. The following mix works well:
  - 1 cement: 6 sand: 1 lime on Aircrete.
- Stainless steel wall ties should be used to minimise corrosion and consequent staining.

Figure 23 Cavity External Walls – Part-filled cavity

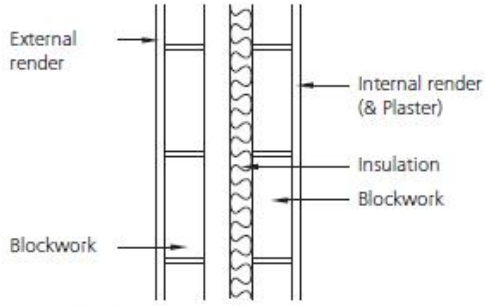


Option A Part-filled cavity

Part-filled cavity – Option A

- External face consisting of engineering bricks up to required level for flood protection (up to 0.6m maximum above floor level plus one course). Other external facing materials can be used above this level, but ensure interface is watertight.
- Rigid insulation.
- Internal face consisting of blocks.
- Internal cement based render, preferably with lime content. Composition depends on masonry; the following mix is effective:

  1 cement : 6 sand: 1 lime on Aircrete.
- Ensure stainless steel wall ties are used to minimise corrosion and consequent staining.
- Sacrificial plasterboard can be used, but it needs to be removed between ground floor and flood level. The board should be fitted horizontally to make removal easier. In some cases a dado rail can be used to cover the joints.



Option B

Part-filled cavity – Option B

- External cement based render, preferably with lime content. Composition depends on masonry; the following mixes are effective:

  1 cement : 4 sand: ½ lime on concrete blockwork

  1 cement : 6 sand: 1 lime on Aircrete.
- External face consisting of blocks.
- Rigid insulation.
- Internal face consisting of blocks.
- Internal cement based render, preferably with lime content. Composition depends on masonry; the following mix is effective for flood resilience:

  1 cement : 6 sand: 1 lime on Aircrete.
- Ensure stainless steel wall ties are used to minimise corrosion and consequent staining.

3.4.5.2 Water entry strategy

This strategy is applicable to design flood depths above 0.6m, or above 0.3m if the structural assessment of the design shows that the integrity of the building would be compromised by a "water exclusion strategy".

General advice for resilient design

Ensure high quality workmanship at all stages of construction.

Masonry walls:

Use good quality facing bricks for the external face of cavity walls.

Do not use soft bricks, such as handmade clay bricks, which can easily crumble when subjected to water.

Concrete blocks dry more quickly than Air Crete blocks. However, Air Crete blocks allow less leakage. Therefore, design of blockwork walls needs to take into account these two opposite types of behavior and consider whether drying or resistance to water is most relevant in each situation. For a "water entry strategy" which is aimed at allowing water passage through the property, concrete blocks are recommended.

Clear cavity walls, i.e. with no insulation, have better resilience characteristics than filled or part filled cavity walls as they dry more quickly.

Framed walls: Avoid timber framed walls containing construction materials that have poor performance in floods, namely oriented strand board and mineral fiber insulation. Timber framed walls are generally not recommended, unless a sacrificial approach is adopted whereby some materials will be stripped to allow drying.

Steel framed walls may offer a suitable alternative option but specialist advice needs to be sought on how to incorporate resilient materials/construction methods in the design. The possible use of bituminous paint on steel plates may be a means of preventing corrosion.

External renders should not be used as they provide a barrier to water penetration and may induce excessive differences in depth between outside and inside of the property resulting in possible structural problems.

Insulation:

External insulation is better than cavity insulation because it is easily replaced if necessary; however, it is generally protected by rigid lining which may create a barrier to water.

Cavity insulation should incorporate rigid closed cell materials as these retain integrity and have low moisture take-up. Other common types, such as mineral fiber batts, are not generally recommended as they can remain wet several months after exposure to flood water which slows down the wall drying process. Blown-in insulation can slump due to excessive moisture uptake, and some types can retain high levels of moisture for long periods of time (under natural drying conditions).

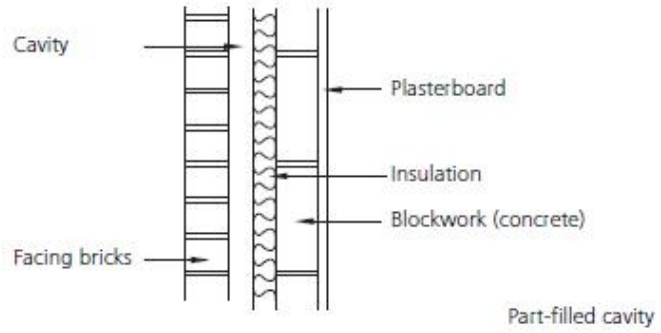
Internal linings:

Avoid internal cement renders as these can prevent effective drying.

Use standard gypsum plasterboard up to the predicted flood level (plus freeboard of 50mm) as a sacrificial material. For this purpose, the use of a dado rail to separate the above and below flooded area may be useful. Splash proof boards do not necessarily offer better protection against flood waters, which may remain for some time and exert pressure on the board.

Above predicted flood level (plus freeboard) the use of plasterboard or internal cement renders is appropriate.

Figure 24 Cavity External Walls – Part-filled cavity with sacrificial plasterboard



Part-filled cavity

- External face consisting of engineering bricks up to required level for flood protection (up to d.p.c.). Other external facing materials can be used above this level, but ensure transition is watertight.
- Rigid insulation
- Internal cement based render, preferably with lime content. Composition depends on masonry; the following mix is effective:

  1 cement : 6 sand: 1 lime on concrete blocks.
- Stainless steel wall ties should be used to minimise corrosion and consequent staining.
- Sacrificial plasterboard can be used, but it needs to be removed between ground floor to flood level. The board should be laid horizontally to make removal easier.

3.4.6 Doors and windows

Doors, windows and air vents are potential flow paths into properties.

General advice for resilient/resistant design

Doors: Raising the threshold as high as possible, while complying with level access requirements, should be considered as the primary measure. In addition, sealed PVC external framed doors should be used and, where the use of wooden doors is a preferred option, all effort should be made to ensure a good fit and seal to their frames.

Hollow core timber internal doors should not be used where the predicted frequency of flooding is high. Where sufficient flood warning is given, butt hinges, that allow internal doors to be easily removed and stored in dry areas prior to a flood, should be used. Where the frequency of predicted

flooding is low or where there is no warning (e.g. overland or sewer flooding) it may be necessary to replace the doors after the flood.

Windows/patio doors: Windows and patio doors are vulnerable to flood water and similar measures to those used for doors should be taken. Special care should be taken to ensure adequate sealing of any PVC window/door sills to the fabric of the house. Of particular concern would be excessive water pressure on the glazing of patio doors. Double glazing conforming to the relevant standards would in principle adequately resist the pressures generated by flood waters; debris carrying flows may cause damage.

Air vents: special designs of air vent are available in the market to prevent water ingress in circumstances where the predicted flood depth is low (i.e. < 0.3m); e.g. periscopic air vent,

3.4.7 Furniture, kitchen, electrical appliances and household goods

3.4.7.1 Water entry strategy

General advice for resilient design

A flood 'resilience' approach aims to reduce the impact and damage caused by floodwater once it enters a property, resulting in quick and easy cleaning, drying, recovery and reoccupation of the property. **This could potentially eliminate the need for an insurance claim.** Resilient measures usually involve changes to the fabric of the building so no action is needed to activate them in the event of a flood. **Undertaking a resilience approach directly after the home has flooded presents an opportunity to reinstate the property with water resilient materials and design**.

Flood resilient work included:

- A pump is under the floor to pump any flood water outside.
- Closed cell insulation under the floor.
- A waterproof sub floor membrane (which can cope with being under water for 30 days) and then an engineered oak floor finish on top.
- Cavity wall insulation replaced with water proof insulation.

- Cement render to the walls.
- Electric sockets further up the walls, wires now come down the walls.
- Waterproof rendering was applied underground to the foundations and 30cm
- (12') above ground.
- Water resistant spray to walls above the render.
- Self-closing air bricks.
- Exit points for waste pipes have all been sealed.
- Rooms without floor voids have been raised, concreted and have been tiled with
- ceramic tiles.
- The kitchen is on legs with removable kick boards.
- They have 2 puddle sucker pumps (which can pump down to 2mm of water), a spare
- pump and a generator.
- Rob has built a wall with substantial foundations in the garden.
- They have non-return valves fitted to the sewers.
- White goods are raised up on plinths.
- Shower, sink and washing machine have separate non-return valves.

Some pictures as illustration of a flood resilient house

A waterproof sub floor membrane with an engineered oak floor on top.

A waterproof sub floor membrane with an engineered oak floor on top.




Electric sockets further up the walls, barriers to all external doors and non-return valves fitted.


White goods are raised up.

The kitchen is on legs with removable kick boards.

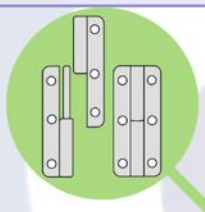
Water Sector Performance and Investment Programme
WPIP MIP V
Institutional Consultant
Municipal Infrastructure Programme V

Images and graphics are by The Flood Hub

LOW COST PROPERTY FLOOD RESILIENCE

Our climate is changing and we are seeing differences in weather patterns, resulting in more extreme weather events and an increased chance of flooding. Property flood resilience measures (PFR) can help to reduce the impact of flooding and the damage caused, however they are sometime costly to buy. Here are some more affordable PFR options you can consider using to help protect your property.

Waterproof paints, sealants & tiles



Lift-off hinges on internal doors

Airbrick cover

Rugs on stone flooring instead of carpet

Alternative sandbags

Repointing

Toilet pan seal

Raise electrical appliances and valuables

Non-return valves

Tins/crates to lift furniture

Puddle pump

Further information can be found in our Property Flood Resilience (PFR) booklet.

If you have recently flooded and are in the recovery process, repairing and reinstating your property could cost thousands. Building back better and putting PFR in place doesn't cost much extra and could provide vital protection, prevent insurance claims and reduce future recovery costs.

Last reviewed: March 2021
For more information visit:
www.thefloodhub.co.uk
@TheFloodHub

4 Food safety in the home after flooding

This fact sheet provides food safety information for consumers and members of the public who have been affected by floods and power cuts.

Don't eat food that's been in contact with floodwaters

1 Floodwaters can be contaminated with sewage; bacteria, viruses, and parasites; chemical contaminants such as pesticides, heavy metals, and petroleum products; and physical contaminants such as glass and debris.

2 Because of this, do not consume any food that has been in contact with floodwaters. All contaminated food (apart from tins) needs to be thrown away, including anything in twist-top bottles or stored in containers.

3 Unopened, undamaged tins need to be washed thoroughly in clean, soapy water before being opened and used. Dry them thoroughly if they're being stored so they don't rust. Discard tins that are deeply dented, particularly around the seams, or heavily rusted.

4 If you have been given food, make sure you know where it comes from and that the donated food has not been in contact with floodwaters.

Power failures: What to do with the food in your fridge and freezer

When the power goes out, here's what to do to avoid getting sick from unsafe food:

5 Eat foods that will expire soon first – such as bread, meat, salads, and dairy products – because they spoil more quickly than non-perishable food.

6 During the power failure, open your fridge or freezer as little as possible to help keep it cooler for longer. Unopened fridges should hold refrigeration temperature for 4 hours.

7 Freezers will remain colder for longer if they are full (2–4 days) compared to if they are half full (1–2 days). So, leave already frozen food in the freezer if possible.

8 Eat your canned and non-perishable pantry foods last.

Refreezing food

Once the power is back on, check the food in your freezer.

9 If the food is still visibly frozen (for example, if it still has ice crystals on it) and the packaging isn't damaged or open, you can safely refreeze it.

10 If the food has thawed, you should not refreeze it.

11 You can still keep or use thawed food if it has not started to look or smell bad. Keep it cold (like in the fridge) until you are ready to eat or cook it.

Produce from your garden

1. If you have a vege patch or fruit trees, do not eat vegetables or fruit submerged by or even splashed by floodwater.
2. Clean up and remove debris from your garden and sprinkle it with garden lime, if available.
3. Produce that has been damaged only by rain, and which has not come into contact with any floodwater, should be safe to eat once washed.

Focus on hygiene when preparing and cooking food

Maintaining hygiene around food preparation and cooking will require more thought than normal but is still essential to keep you and your whānau healthy.

4. Always wash your hands and, if possible, dry them before preparing food – if water is in short supply, keep some in a bowl with disinfectant.
5. Ensure all kitchen utensils and food-preparation surfaces are clean before and after use.
6. Cook food thoroughly.

How to keep your water safe and clean

Check if there are any boil-water notices in your area. You'll need clean water to cook, wash dishes, and wash your hands.

If you do not have safe running water:

7. You can use water from a hot-water cylinder, a toilet cistern – as long as no chemical toilet cleaner is present – or bottled water.
8. Boil or purify water before using it in food preparation to avoid spreading viruses and bacteria between food. Re-boil the water if it is not used within 24 hours.
9. If you are not able to boil water, use purifying tablets or bleach to ensure water safety. Add 5 drops of household bleach per litre of water (or half a teaspoon for 10 litres) and leave for 30 minutes. Do not use bleaches with added scent or perfume, surfactants, or other additives – they can make people sick.

Disposing of food

If in doubt, throw it out. All perishable food can become unsafe to eat if it reaches temperatures where harmful bacteria can grow and cause of food poisoning.

10. Does the food from your fridge, freezer or pantry smell or look different? Has the colour changed and does it have a slimy texture? If so, it's likely unsafe and should be binned.
11. Throw away all food (except cans) and drinking water that have come into contact with floodwater, including items in twist-top bottles or stored in containers.
12. Place food waste in bin bags to avoid attracting rats, mice, and flies.

Collecting kai moana

13. Avoid collecting live seafood from the ocean straight after any large-storm events due to the increased risk of contamination from stormwater runoff or overflows from sewerage systems.
14. Do not gather any dead fish or shellfish that have washed up on beaches, no matter how fresh they may look, as they can contain harmful bacteria.

5 General Guidelines for Inspection and Maintenance of Storm Water Drainage Infrastructure

Inspection and maintenance of storm water control facilities such as retention/ detention basins and earthen drainage channels is necessary to ensure that these facilities are generally in good condition and operating as designed to manage and/ or convey storm water runoff. Drainage infrastructure should be inspected routinely during normal conditions and during storm events when storm water is present and being conveyed through drainage channels and basins. General maintenance items are included below for detention/ retention facilities and drainage channels. Design plans and maintenance plans should be consulted prior to conducting maintenance work.

5.1 Detention/ Retention Basin Maintenance

- Vegetation management
  - Overgrown vegetation has the potential to obstruct storm water flows and reduce the design capacity of the basin. Inspections shall be conducted routinely to verify that vegetation growth is kept to 18" or less.

Mowing is generally required when grasses and vegetation exceed 18" in height. Woody vegetation such as trees and large shrubs should not be evident in basins and should be removed if observed. Sufficient grassy vegetation should be established within the basin to prevent erosion.

  - If grass coverage is sparse and erosion is evident, native grass seed should be distributed in bare areas to promote vegetation coverage and stabilization.
- Sediment accumulations
  - Significant sediment accumulations have the potential to decrease the capacity of the basin. Sediment accumulations may also be readily exported from the basin and into surface waters and/ or the City's storm drain system. Routine inspections should be conducted to verify that the basin outlet and areas immediately downstream are free of significant sediment accumulations. Inspections should also occur on a routine basis to verify that sediment has not filled the basin by 10% or more of the original basin volume.
  - Removal of sediment and accumulated material from basin may be required if significant sediment accumulations are evident and reduce the capacity and functionality of the basin. If sediment accumulations are removed, it may be necessary to re-seed the disturbed area with a native grass seed mix.
- Obstructions
  - The inlet and outlet structures of the basin shall be inspected routinely to look for signs of erosion or obstructions. Obstruction of the basin inlet and outlet structures has the potential to impede flow into and from the basin.
- Presence of debris/ litter
  - Excessive litter and debris shall be removed from basins.
- Erosion/ Scouring

- Significant erosion has the potential to cause failure of basin walls. Eroded material has the potential to be exported from the basin into surface waters and/ or the City's storm drain system. If erosion is evident, revegetation with native grasses may be needed to help stabilize bare areas and prevent further erosion and scouring. Structural work may be required in areas where excessive erosion has occurred.

- Nuisance
  - Standing water in the basin during dry periods can decrease the capacity of the basin and provide optimal habitat conditions for mosquitoes and other vectors. Ensure that there is no standing water during dry periods and no odors caused by stagnant conditions.

5.2 Earthen Drainage Channel Maintenance

- Vegetation management
  - Overgrown vegetation has the potential to obstruct storm water flow and reduce the carrying capacity of the channel. Inspections shall be conducted routinely to verify that vegetation growth is kept to 18" or less.

Mowing is generally required when grasses and vegetation exceed 18" in height. Woody vegetation such as trees and large shrubs should not be evident in channels and should be removed if observed. Sufficient grassy vegetation should be established within the drainage channel to prevent erosion.

  - If grass coverage is sparse and erosion is evident, native grass seed should be distributed in bare areas to encourage growth and stabilization.

- Sediment accumulations
  - Significant sediment accumulations have the potential to decrease the capacity of the channel and obstruct flow. Routine inspections should be conducted to verify that the channel is free of significant sediment accumulations.
  - Removal of sediment and accumulated material from channel may be required if significant sediment accumulations are evident and prevent positive drainage through the channel.

- Obstructions
  - Structures and other obstructions should not be located within the channel. Fences, trees and excessive vegetation are all considered drainage obstructions and should be removed to allow positive drainage through the channel.

- Presence of debris/ litter
  - Excessive litter and debris accumulations shall be removed from drainage channels.

- Erosion/ Scouring
  - Significant erosion has the potential to cause failure of channel walls and causes eroded material to be transported to surface waters and/ or the City's storm drain system. Native grasses may be needed to help stabilize bare areas and prevent further erosion and scouring. Structural work may be required in areas where excessive erosion has occurred.

- Nuisance
  - Standing water should not be evident in drainage channel during dry periods.

Standing water provides optimal habitat conditions for mosquitoes and other vectors. Ensure that there is no standing water during dry periods and no odors caused by stagnant conditions.

6 Acronyms

ACRONYM	EXPLANATION
AEP	Annual Exceedance Probability
CI	Context Indicators
DRR	Disaster Risk Reduction
DRM	Disaster Risk Management
EOC	Emergency Operation Centre
EU	European Union
EUFD	European Union Flood Directive
EU MS	EU Member State
EWS	Early Warning System
GDCE	General Directorate for Civil Emergency
IGEWE	Institute of GeoSciences
IASC	Inter-Agency Standing Committee
MHEWS	Multi Hazard Early Warning System
NEOC	National Emergency Operation Center
NCFMNH	National Center for Forecast and Monitoring of Natural Hazards
NCEP	National Civil Emergency Plan
OECD	Organisation for Economic Co-operation and Development
PDNA	Post Disaster Need Assessment
SI	Status Indicator
UNISDR	United Nation International Strategy for Disaster Reduction
UNDRR	United Nation Disaster Risk Reduction
UK	Water Utility
WFD	Water Framework Directive
WMO	World Meteorological Organization