

# Operational planning for managing a disaster resulting from a natural hazard in an urban environment; Case of managing a flood disaster in the locality of Bab El Oued, Algiers (Algeria) according to a probable scenario

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## Abstract

*The concept of a nation facing natural hazards represents a significant impediment to the economic and social development of a given territory, necessitating the adoption of a rational and studied approach to address this critical situation. Among the various natural hazards, flooding stands out as one of the most perilous phenomena, capable of inflicting extensive damage on lives, economies, and environments.*

*The locality of Bab El Oued has experienced a poignant episode in its history concerning flood-related damages during the year 2001. The risk in this area is classified as very high, underscoring the imperative to continually reassess preventive measures and disaster management protocols should flooding occur. This imperative is underscored by the intertwining of natural and human factors, rendering the risk a devastating reality and a constraint on sustainable development.*

*This dissertation endeavors to explore intelligent solutions for flood disaster management in the highly threatened Bab El Oued neighborhood, within the framework of prevailing legislation and regulations, contingent upon a plausible scenario.*

**Keywords:** Bab el Oued, Oued Koriche watershed, flood hazard, issues, risk, legislation and regulations, prevention, rescue organization, scenario.

## 1. Introduction

Societal developments and increasing expectations regarding civil security, particularly concerning flood risks, necessitate comprehensive recognition and in-depth studies to establish a risk prevention and disaster management system. Global decision-makers have adopted an approach combining prevention and intervention, strengthening entities involved in combating the undesirable consequences of disasters. This entails prior formulation of preventive strategies involving all relevant stakeholders, alongside operational planning ready to be implemented during disasters, aiming to mitigate their effects.

Like other nations, Algeria has faced numerous natural disasters, notably floods such as those in Bab El Oued in 2001 and Ghardaïa in 2008, resulting in significant human and material losses and disrupting urban life due to infrastructure destruction. While zero risk may not be achievable, limiting, managing, and reducing these risks remain at the forefront of municipal authorities' concerns. This necessitates the establishment of organizational tools such as Emergency Response Plans (OR-SEC plans), mobilizing all city stakeholders to intervene and coordinate efforts to save lives and restore degraded areas.

The urban district of Bab El Oued is currently grappling with major flooding issues due to its location in an extensive watershed area and high rainfall. Floods pose a threat to natural and physical spaces as well as to individuals and their property with each rainfall event, causing significant material damage and human losses. Hence, understanding this phenomenon is imperative to predict and mitigate its effects.

To address these issues, a strategy for major risk prevention coupled with operational planning during disasters serves as a reliable roadmap to maintain an acceptable level of security and effectively manage disaster effects. However, it is pertinent to question whether current prevention measures adequately meet the challenges posed by the combination of hazards and existing stakes, and whether there is a studied planning capable of addressing extreme floods.

## **2. Legislative and Regulatory Framework for Major Risk Prevention**

Major risk prevention is a significant issue for urban management. Therefore, a legal framework has been established in this context.

### **2.1. Law No. 04-20 of December 25, 2004, concerning major risk prevention and disaster management within the framework of sustainable development. (Articles 15 to 49):**

Regarding major risk prevention, this law incorporates elements aimed at systematically reducing risks (damage of all kinds), including the following aspects:

#### ***a. Principles underlying this law (Chapter I, Article 8):***

- Precautionary and prudential principles (data collection and risk analysis).
- Principle of concurrence (probability of multiple disasters occurring simultaneously).
- Principle of preventive action and correction at the source (prevention treatment at the source of the problem).
- Principle of participation (every citizen should have access to information regarding:
- Risks incurred in places of residence and activities,
- Preventive measures, and ultimately,
- Crisis management provisions).
- Principle of integration of new techniques (continuous monitoring of innovations and updates related to the subject).

**b. *Discrimination of Risks to Prevent (Chapter III, Article 10):***

Law 04-20 has identified the major risks threatening the Algerian territory, which include:

- Earthquakes and geological risks.
- Floods.
- Climatic risks.
- Forest fires.
- Industrial and energy risks.
- Radiological and nuclear risks.
- Risks affecting human health.
- Risks affecting animal and plant health.
- Atmospheric, telluric, marine, or water pollution.
- Disasters due to significant human gatherings.

**c. *Information (Chapter IV, Articles 11 to 13):***

Through this law, the Algerian legislature has opted for a policy of extensive information for the benefit of citizens, primarily by:

- Ensuring citizens have equal and permanent access to all information regarding major risks.

**2.2. Ordinance 03-12 of August 26, 2003, regarding the obligation of insurance for natural disasters and the compensation of victims, notably Article 1:**

This ordinance mandates insurance for any individual owning real estate or engaging in industrial or commercial activities. Insurance contracts are required for all real estate transactions or during tax declarations. The ordinance stipulates that insurance companies must provide coverage against the effects of natural disasters with state guarantee and determine the conditions for compensation.

**2.3. Law "04-05" of August 14, 2004, amending and supplementing Law 90-29 of December 1, 1990, concerning planning and urban development:**

This law particularly emphasizes limitations on construction in plots directly exposed to natural and technological risks. It mandates Urban Development Plans (PDAU) and Land Use Plans (POS) to define development and construction conditions while considering the prevention of natural and technological risks.

Additionally, Law "04-05" introduces provisions for the demolition of constructions built in violation of urban planning and construction regulations (e.g., on easements or non-aedificandi zones). These measures, upon their enforceability against third parties, can curb unregulated expansions on lands exposed to risks.

#### **2.4. Executive Decree No. 04-268 of August 29, 2004:**

This decree identifies natural events covered by the obligation of insurance against the effects of natural disasters and establishes procedures for declaring a state of natural disaster. Covered events include earthquakes, floods and mudslides, storms and strong winds, and ground movements.

The decree stipulates that the state of natural disaster must be declared by an inter-ministerial decree issued by the ministers responsible for local authorities and finance no later than two months after the event, based on a report from the concerned governors.

#### **2.5. Executive Decree 04-270 of August 29, 2004:**

This decree defines standard clauses to be included in contracts for insuring against the effects of natural disasters. It provides a classification of insurance policies based on a legal framework.

#### **2.6. Executive Decree No. 04-181 of June 24, 2004:**

This decree establishes the commission for communication related to major natural and technological risks. Its mission is to define and propose to the government the national communication strategy related to major natural and technological risks and to implement it.

#### **2.7. Decree No. 85-232 of August 25, 1985, concerning the prevention of disaster risks:**

This decree comprises 11 articles. The term "Risk Prevention Plan," of natural or technological origin, is mentioned (Article 2), albeit without a detailed description of its objectives, content, and implementation. It requires local authorities to cooperate with each other in the event of a disaster.

### **3. Legislative and Regulatory Framework for Disaster Management**

#### **3.1. Law No. 04-20 of December 25, 2004, concerning the prevention of major risks and disaster management within the framework of sustainable development (Articles 50 to 57):**

In order to complement and harmonize all provisions enabling the best management of natural and technological disasters, Law No. 04-20 was published on December 25, 2004. This law relates to the prevention of major risks and disaster management within the framework of sustainable development.

This law integrates, in the same desire for systematic risk reduction (thus losses of all kinds), elements concerning the summarized aspects in the following table:

**Table 1. Summary of the objectives of Law 04/20 (within the framework of disaster management)**

Content	Observations
<b>Disaster management</b>	<p>Planning rescue and intervention operations.</p> <p>Definition of "ORSEC Plans" at all levels: national, inter-wilayas, wilayas, municipalities, sites.</p> <p>Taking care of buildings of strategic value in the development of these plans.</p> <p>Article 54: The organization and planning of rescue operations must be designed to prioritize the following intervention segments:</p> <ul style="list-style-type: none"> <li>• Rescue and assistance to individuals.</li> <li>• Establishment of secure temporary accommodation sites.</li> <li>• Rational management of aid.</li> <li>• Security and health of the affected population and their property.</li> <li>• Provision of drinking water.</li> <li>• Establishment of energy supply.</li> </ul> <p>Article 57: The intervention of the People's National Army in rescue operations in the event of disasters is governed by rules set forth in Law No. 91-23 of December 6, 1991, relating to the participation of the People's National Army in missions to safeguard public order outside of exceptional situations.</p>

### **3.2. Executive Decree No. 85-231 of August 25, 1985, setting the conditions and modalities for the organization and implementation of interventions and assistance in the event of disasters:**

This decree allowed for the establishment of "Organization of Interventions and Assistance Plans" (ORSEC Plans) at the level of wilayas, municipalities, etc. (for more details on the ORSEC plan, see the annexes).

This decree was the basis for disaster management in Algeria for 32 years. However, after the Boumerdes earthquake and the torrential flooding in Bab el Oued, Law 04/20 repealed this decree.

## **4. Wilaya Intervention and Assistance Organization Plan (OR-SEC WILAYA)**

### **4.1. Definition of the OR-SEC plan:**

The OR-SEC (Organization of Assistance) plan is the establishment of precise instruments specifying the roles and responsibilities of various stakeholders in the event of various disasters, aiming to save as many victims and properties as possible. It is the responsibility of the ORSEC plan to define the authorities and command structures, specify the triggering mode, identify available public and private resources, and specify the missions of the operational structure services.

#### 4.2. Sensitization Actions:

Only continuous public awareness of these issues can enable effective reactions, leading to rational actions to save as many lives as possible and to design a logical post-crisis organization, in coordination with all authorities responsible for operations, within the framework of the various ORSEC Plans." The following table summarizes the appropriate recommendations for each disaster.

**Table 2. The recommended recommendations in case of disaster**

<b>Before disaster</b>	
Get informed about warning signals and evacuation procedures. If there is an imminent risk of flooding, shut off heating appliances, gas, and electricity. Move your furniture, electrical appliances, and other personal effects to higher floors. Place toxic products, such as bleach, in secure locations to prevent pollution.	
<b>During the disaster</b>	
<b>If you are indoors</b>	<b>If you are in a car</b>
Keep calm. Alert your neighbors and especially assist the disabled, children, and elderly. Stay informed about the danger and its evolution. Listen to the radio. Do not use the phone to avoid overloading the network. Leave your home as soon as emergency responders request it. Follow the route indicated by authorities. Do not take shortcuts, as you may end up in a dead end or dangerous place. Make arrangements for pets. Only take the essentials (first aid kit, identification and personal papers, and medications).	Avoid driving on a flooded road, as you risk being swept away by the current. If you find yourself in a flooded area and your car breaks down, abandon it and seek help for yourself and your passengers.
<b>After disaster</b>	
Come to the aid of the injured and bring your first aid kit. Stay tuned to your radio and follow the instructions of the rescue operation authorities. Ensure the structural safety of your surroundings (strength of walls, floor, broken glass, and other dangerous debris). Do not delay in pouring about 2 liters of bleach into stagnant water, but be careful of electrical shocks. In flooded areas, immediately cut off the power at the electrical distribution panel. If the floor near the distribution panel is wet, stand on a plank to stay dry and turn off the power using a wooden stick.	

Use boiling water or a sterilizing solution (about a teaspoon of bleach in a sink full of water).

Empty the house of all dirty and wet materials.

Remove remaining mud and dirt, and discard damaged furniture, appliances, clothing, and bedding.

## 5. Prevention of flooding risk

Reducing vulnerability also involves implementing technical measures and protection aimed at mitigating exposure to hazards by safeguarding vulnerable elements. In this chapter, we will present the structures implemented in this framework and the structural technical proposals that can reduce the risk of flooding.

### 5.1. Structural Actions

Following the torrential floods of November 2001, which caused dozens of casualties and extraordinary property and civil security losses, public authorities opted for a project to duplicate the main collector of Oued M'Kessel in order to drain rainwater from the upstream to the downstream through an underground canal.

#### 5.1.1. Completed Works

##### *a. Oued M'Kessel duplication project*

Following the violent floods of November 2001, duplication of this collector was decided upon by the Water Resources Directorate of the Wilaya of Algiers (DRE), with the following characteristics being established:

**Table 3. Technical datasheet of the new collector**

<b>Length</b>	4650 m, between the junction with the secondary Baranes river and the discharge into the sea
<b>Type of collector</b>	Circular (to reduce roughness and viscosity)
<b>Diameter</b>	Ø 4000 mm
<b>Construction method</b>	Underground tunnel
<b>Materials used</b>	Stone

This collector will evacuate runoff from all sub-basins (tributaries of the Koriche wadi), taking into account sediment issues, slope, and canal roughness, which are addressed in the study following the implementation of this project, such as:

- The construction of two storm overflows to reduce runoff velocity.
- The construction of two desilting basins to protect the collector from sedimentation in the main canal and save on cleaning work.

From observation of Figure 1, which illustrates the trajectory of the duplication of Oued M'Kessel, we observe that all tributaries are connected to the main collector. A drop shaft is constructed to reduce the flow rate and adjust the gradient.

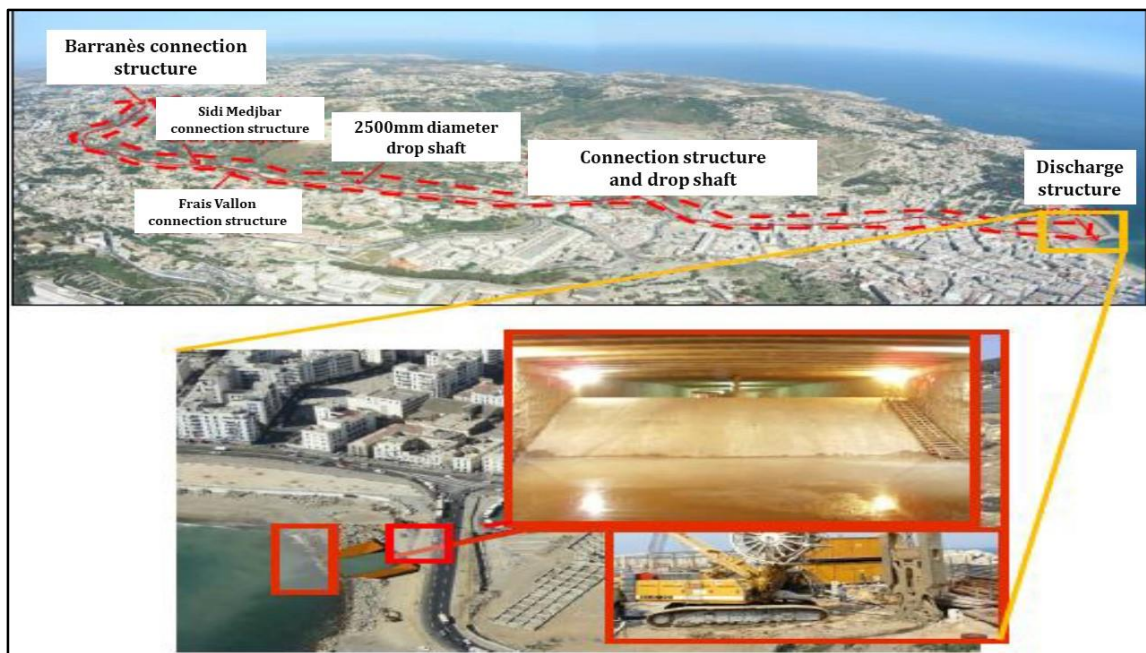


Figure 1. Trajectory of completed collector

#### *b. Upstream rainwater retention basin project*

In order to reduce upstream runoff and protect the proposed main collector, two retention basins have been proposed as shown in the figure 2:

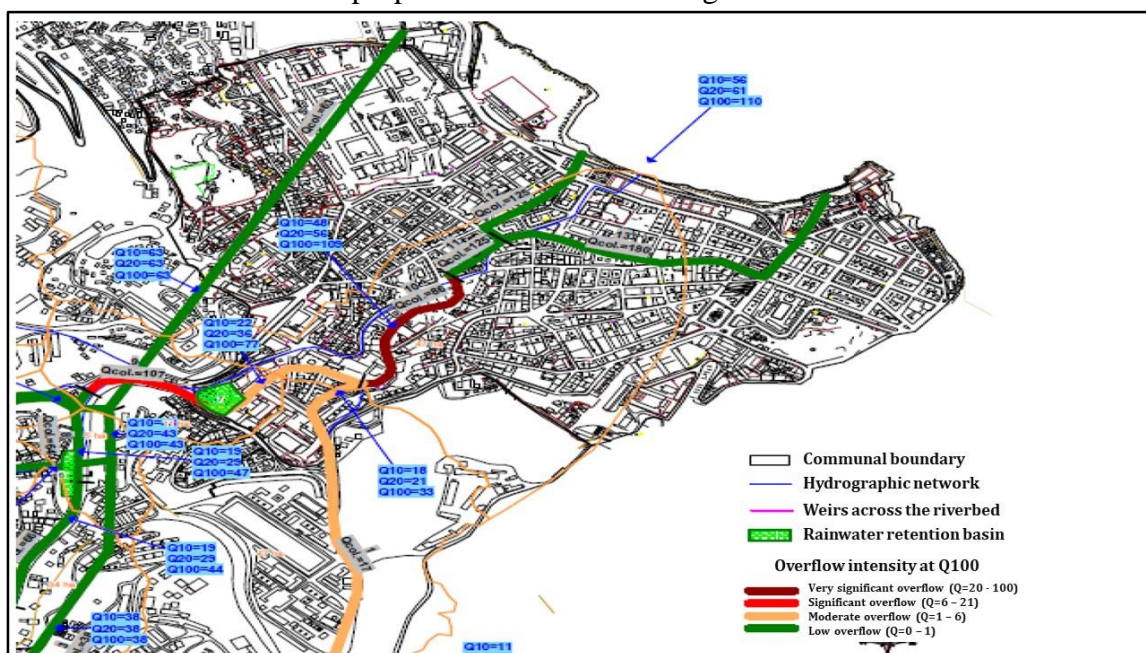


Figure 2. Proposed water retention basin

### 5.1.2. The proposals

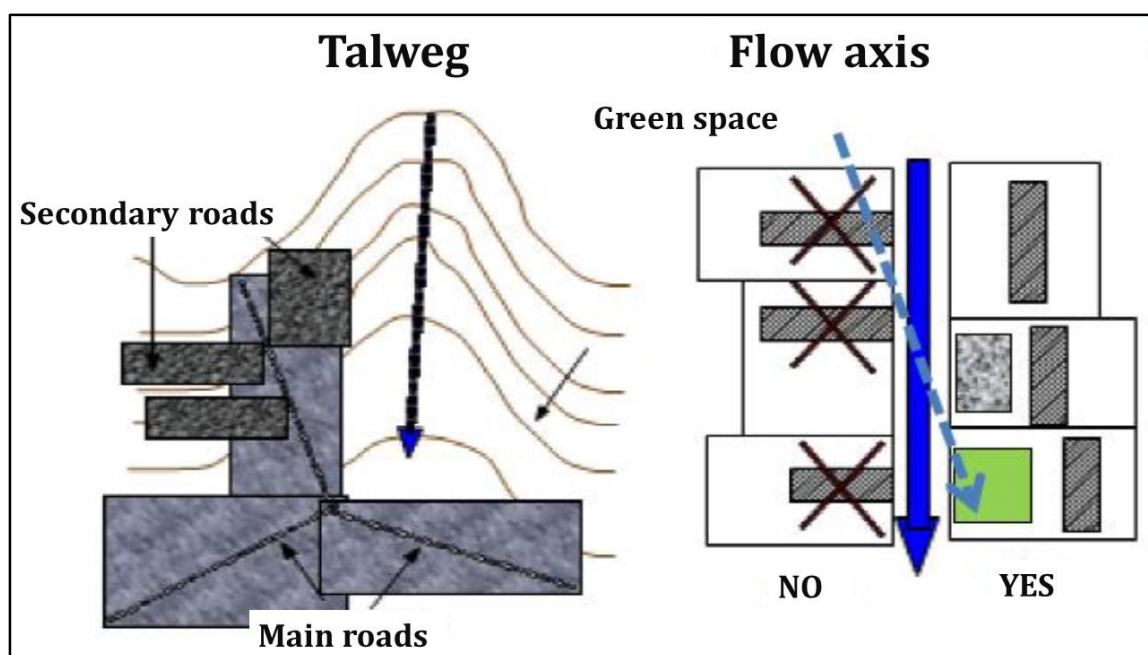
#### *a. In terms of spatial organization*

The management of flood risk involves urban space management. The urban system is divided into a minor system (built environment) and a major system (road networks and infrastructure). Within the major system, the use of green spaces or recreational areas is to be prioritized.



Additionally, the choice between infiltration or retention-focused developments should be made based on the site's capabilities. Moreover, road construction should adhere to the following considerations:

- Secondary and access roads should be oriented parallel to contour lines.
- Main roads (national highways, inter-district roads) should be oriented perpendicular to contour lines to collect rainwater.
- At the outlet of main roads, installations should be implemented to slow down runoff and accommodate excess water. These installations could include parks, recreational areas, as illustrated in the following figure:



**Figure 3. The proposed style of development**

### ***b. Roof Storage***

In order to reduce the quantity of water flowing into the urban system and to durably reinforce the behavior of the rainwater drainage network, roof storage systems are proposed for this purpose. Roof storage systems can be implemented on new buildings or on old buildings provided that the stability and waterproofing of the structures are checked beforehand (the load-bearing capacity of the building frame).

The advantage of this technique lies in its easy integration into the urban landscape (in terms of land use and aesthetics) and its relatively easy implementation, at least for new buildings (integrated into the specifications).

To demonstrate this, assuming there is a centennial flood of "290mm" over a period of 24 hours with a land occupancy rate of 40% and a 25% rate of implemented roof storage systems. The quantity of stored water is measured as follows:

For the Oued Koriche watershed:

- Proposed rainfall depth: 290mm
- Area: 900 hectares
- Proposed land occupancy for the entire watershed: 40%
- 25% of the built-up area is treated by the roof storage systems.
- Water quantity =  $290 * (9000000 * 0.4 * 0.25) = 6,525,000,000$  liters

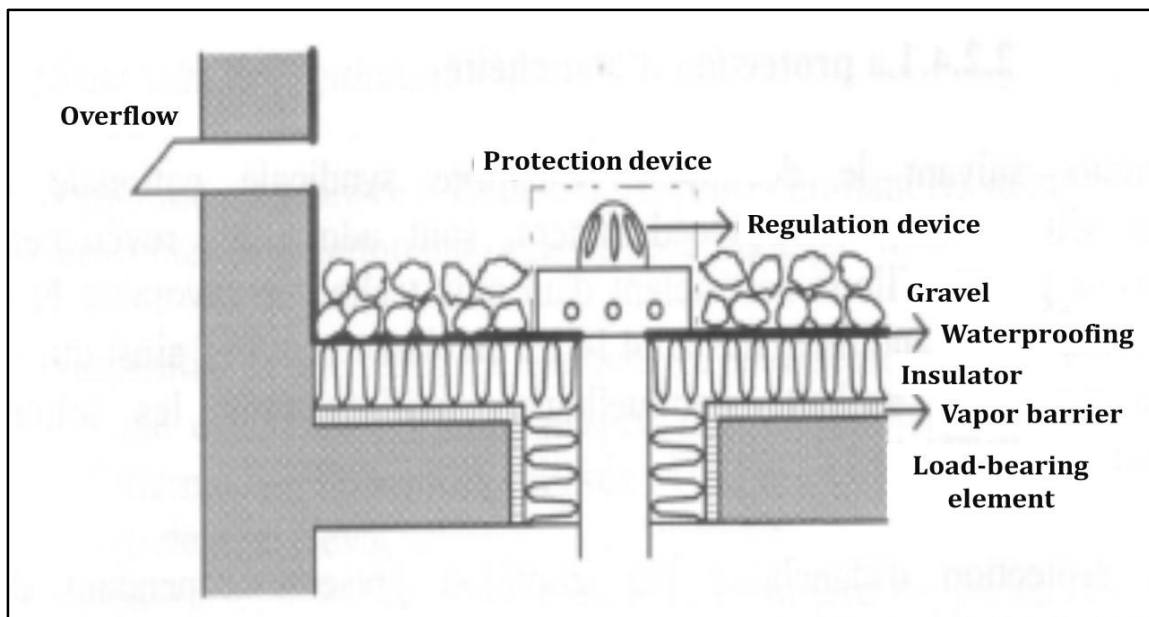
So the stored quantity is equal to  $6,525,000 \text{ m}^3/24$  hours, which is  $271,875 \text{ m}^3/\text{hour}$ .

For the Bab El Oued municipality: (surface area of the municipality is 120 hectares, with a coefficient of 70%)

Water quantity =  $290 \times (1200000 \times 0.70 \times 0.25) = 60,900,000$  liters

So the stored quantity is equal to  $60,900 \text{ m}^3/24$  hours, which is  $2,537.5 \text{ m}^3/\text{hour}$ .

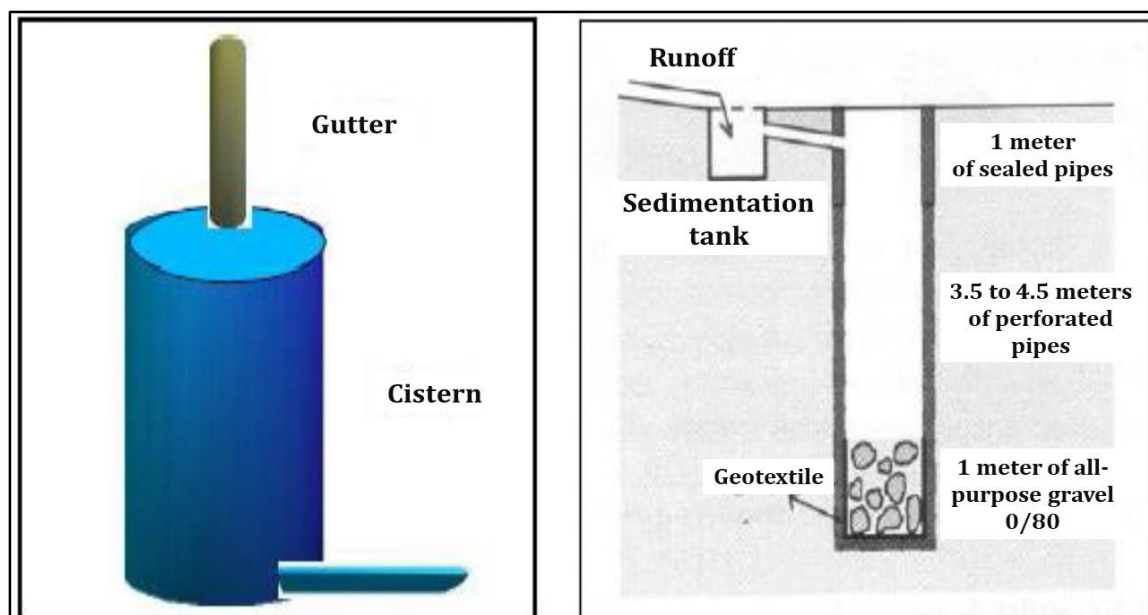
This result highlights the importance of this technique in reducing the vulnerability of the urban area of Bab El Oued to the risk of flooding in a sustainable manner. By reusing this quantity of water for watering green spaces and cleaning outdoor areas through internal technical installations, water waste can be avoided.



**Figure 4. Principle of roof storage**

### *c. Stocking Wells*

The cisterns allow storing a portion of the runoff water before it is used for other purposes (garden watering, street cleaning). The wells promote the infiltration of rainwater through temporary storage in the ground. In both cases, the objective is to limit runoff downstream. Storage cisterns are particularly suitable for the scale of the plot and the dwelling. Wells can be created to drain areas of a few tens of meters.



**Figure 5. Technique of wells and cisterns**

### 5.1.3. Recommendations

To preserve the drainage capacity of the drainage network, permanent maintenance is a fundamental operation, which must be carried out by the technical services of hydraulics, the national sanitation office, and the municipality's resources.

A cleaning program must be established by the aforementioned services, in coordination with the competent authority.

It is also necessary to implement a separate sanitation system.

## 6. Operational Backup Planning Scenario

Specifically, if a disaster occurs, an operational backup plan must be activated immediately. Based on the previously established risk map, this approach consists of two phases, addressing the description of an intervention scenario for a very catastrophic case:

### 6.1. Theoretical Explanation of the Proposed Scenario

This is a preliminary phase to explain and determine the missions to be carried out through this scenario by the following means:

- Consulting all documents, maps, plans useful for the rescue operation, particularly focusing on the flood risk map for the Algiers province, and estimating the possibility of neutralizing the disaster area to facilitate movement, where we will propose escape routes and ensure good accessibility for supply.
- Testing the alert level and testing the effectiveness and performance of available combat means.
- Explaining the reaction of the concerned modules.

Based on the flood risk plans of the Algiers province, especially the Bab el Oued area, the subject of our study located in the downstream part of the Oued Koriche watershed. To this end, we will propose an operational intervention scenario for an extreme torrential flooding situation.

## 6.2. Implementation of the OR-SEC Plan

The execution of the OR-SEC plan is carried out through two alert phases, the first of which concerns the preparatory phase with alert 01, followed by an exercise with alert N002 (when the flood turns into a catastrophe). This is explained as follows:

On March 29, 2016, a Special Weather Bulletin (BMS) issued by the Algerian National Meteorological Office reported that significant thunderstorms (heavy rain) accompanied by hail and gusts of wind reaching 80 to 90 km/h would affect the North-central provinces of the country, notably the province of Algiers and the Bouzareah massif. This alert was issued to take precautionary measures against an expected catastrophic flood.

The Bouzareah, Cap Caxine, and Port of Algiers weather stations confirmed this information with utmost consideration. Consequently, a fixed command post was established at the headquarters of the Algiers province following the activation of alert level N01. This command post was presided over by the Wali (Governor) of the Algiers province, assisted by officials from various intervention modules and security services, who were tasked with the following missions:

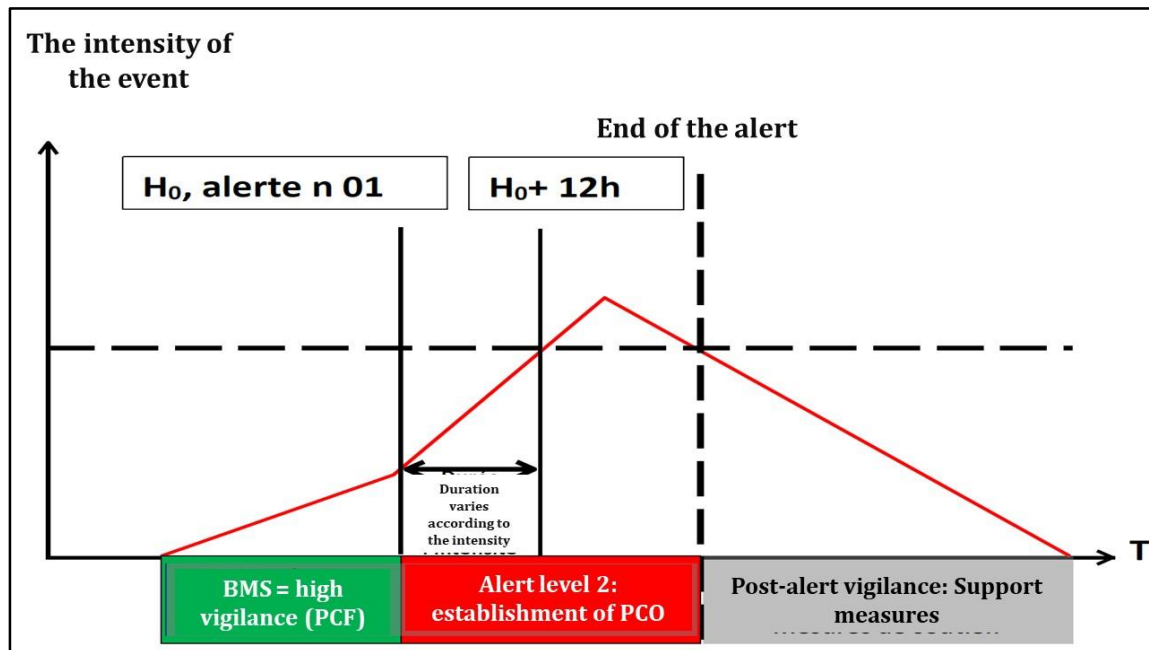
- Immediate deployment of intervention modules.
- Assignment of missions to each responsible individual according to their position and intervention module in the ORSEC plan.
- Determination of human resources and available material means to control the disaster.
- Providing continuous reports to the Wali.

On March 30, 2016, three episodes of freezing rain occurred within twelve hours over the Bouzareah massif and its neighboring areas, resulting in a total rainfall of 290 mm. This led to massive flooding of the Oued Koriche and its tributaries in the Bab el Oued neighborhood, characterized by high population density and intricate urban configuration.

The disaster resulted in 100 casualties, complete disorganization of the electrical grid, leaving over 60,000 people without electricity, sediment clogging the stormwater drainage system, destroyed homes, and missing persons, among other consequences.

Immediately following a decision by the Wali of the Algiers province, alert level N02 was activated, coordinated with the executive council of the Algiers province, and informing the Minister of the Interior and Local Government. The inevitable outcome of this coordination was the establishment of the Operational Command Post (PCO), led by the Director of Civil Protection, in the most heavily affected areas. Taleb Abderrahmane Square and Maillot Hospital were chosen as temporary locations for the operational command post, where rescue operations were organized, and missions for rescue, first aid, and evacuation of victims were distributed.

We also designated evacuation routes for the injured as well as supply routes for human resources and material means.



**Figure 6. Flowchart illustrating the alert process**

The severity of the flooding event can be divided into several alert phases: alert level 01 (PCF), alert level 02 (PCO), and restoration.

Based on Article 54 of Law 04/20 of December 25, 2004, concerning the prevention of major risks and disaster management within the framework of sustainable development.

The organization and planning of rescue operations are designed to prioritize the following intervention segments:

- Rescue and assistance of individuals.
- Establishment of secure temporary shelter sites.
- Rational management of aid.
- Safety and health of the affected individuals and their belongings.
- Provision of potable water.
- Establishment of energy supply.

#### **a. Mission: Rescue and Assistance of Individuals**

The person responsible for carrying out this mission is the director of civil protection, designated by the operational command post (PCO), with an officer overseeing the OR-SEC emergency response on a permanent basis. Regarding logistical support, an officer is appointed to manage material resources and human resources.

All material resources and human resources available to the civil protection directorate of the Algiers province are requisitioned to reinforce rescue operations and evacuate the affected individuals.

We have chosen the main unit of the Algiers province located in Zemirli as the main logistical base, reinforced by two advanced logistical bases in the Bab el Oued area at the Kittani square on one side and the Ferhani stadium on the other side.

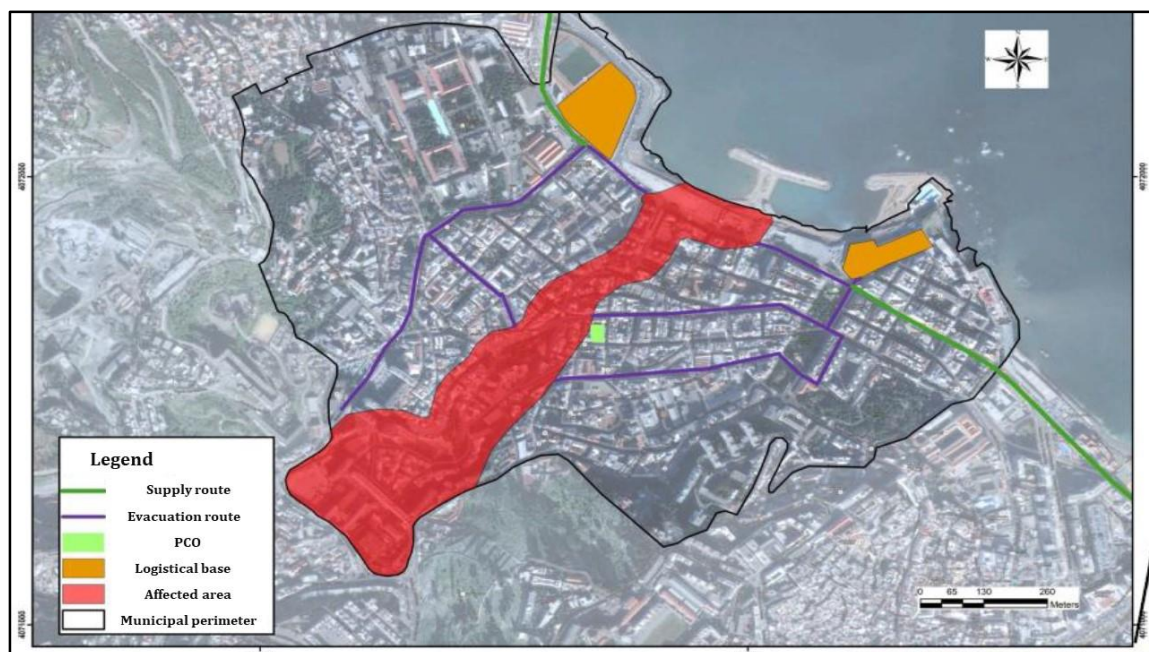
For evacuation routes, we propose complete isolation of the municipality to facilitate movement within the affected area. For the routes connecting the logistical base and the disaster area, the following lines are proposed:

***East side:***

- Rue des Frères Achadi.
- Rue Colonel Abderrahmane Mira.
- Rue Colonel Lotfi.

***West side:***

- Rue Colonel Abderrahmane Mira.
- Rue Amar Benissa.
- Boulevard Saïd Touati.



**Figure 7. Map depicting a rescue and relief mission for individuals**

**b. Mission: Establishment of Secure Temporary Shelter Sites**

The Director of Urban Planning, Architecture, and Construction (DUAC) is the responsible party for carrying out this mission, along with the subdivisional authorities of the Algiers province. To ensure accommodation close to healthcare services, we have selected seven educational establishments distributed as follows:



***To the west:***

- Frantz Fanon High School.
- Al Fârâbî School.
- Okba High School.
- El Soummam Middle School.

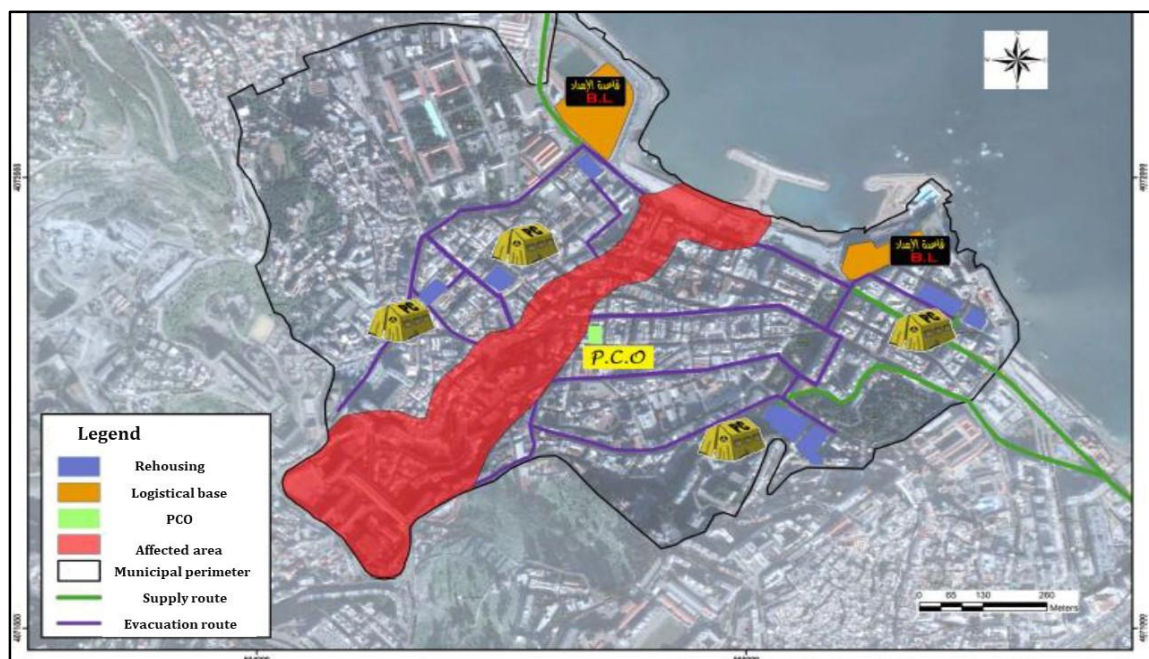
***To the east:***

- Abderrahmane Mira High School.
- And two other schools.

In the presence of representatives from the following services:

- Health services: represented by 02 physicians and four nurses in each center.
- Hydraulic services: two engineers in each resettlement center to ensure water supply and monitor its potability.
- Security services: two personnel in each center.

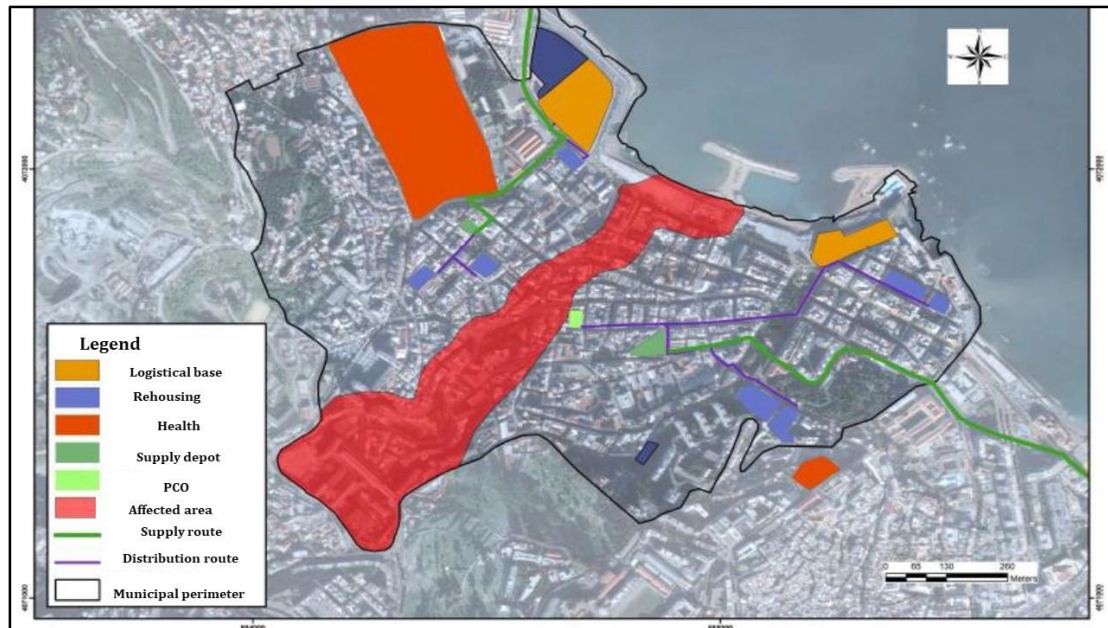
Figure 08 details the spatial distribution of temporary resettlement sites and access routes to these sites.



**Figure 8. Map of the establishment of temporary secure accommodation sites**

**c. Mission: Rational Management of Aid**

To efficiently manage aid intended for the affected individuals and other aid coming from outside the province, the Director of Commerce ensures the smooth functioning of this duty by providing supplies such as food, clothing, blankets, etc. Two refrigerators are allocated for each accommodation center to preserve food products. All measures are taken to ensure the validity and safety of food for consumption. The routes designated for the smooth functioning of this mission are illustrated in Figure. We have selected primary schools for storing aid supplies.



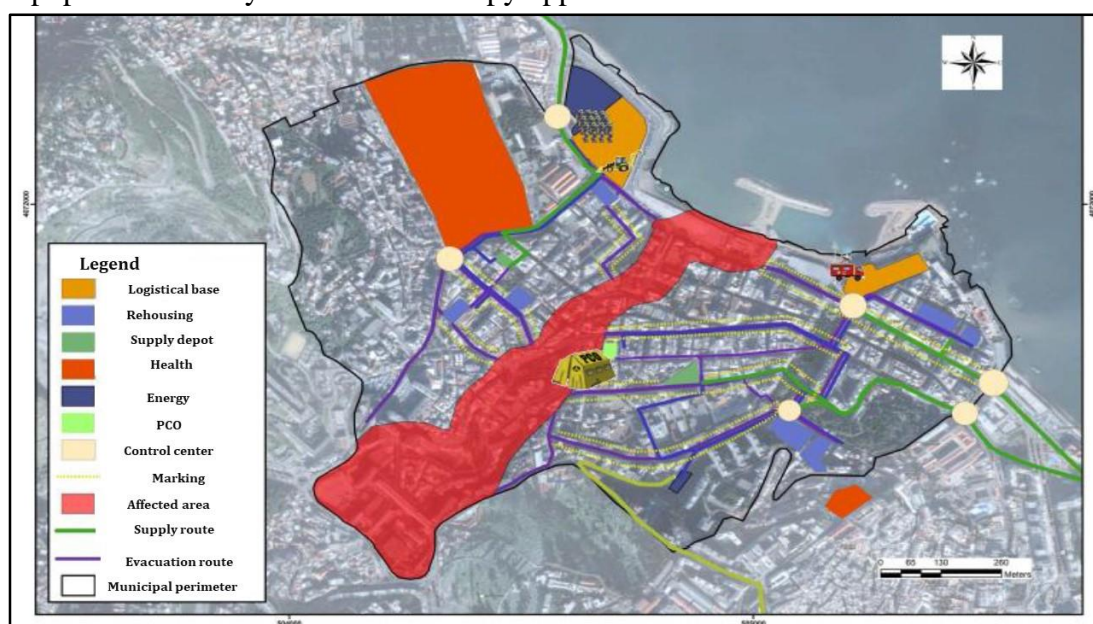
**Figure 9. Map illustrating the mission of rational aid management**

**d. Security and Health of the Affected Individuals and Their Belongings**

***Public Safety Measures:***

A provincial security commission chaired by the Wali of the Algiers province has been established to oversee civil security during the crisis and fulfill the following conditions:

- The police authorities have ensured that all their personnel are equipped with reliable and efficient radio equipment (spare batteries, etc.).
- A specific radio procedure (clearance frequency, special indicators, special transmission orders) has been developed.
- Public Address vehicles will patrol the areas between the alert initiation and H + 6 to urge the population to stay indoors and occupy upper floors.



**Figure 10. Map depicting the mission of public safety**



### ***Health Measures:***

The indispensable objective of this scenario is to preserve public health to the maximum extent possible and save the affected individuals from all types of diseases, whether injuries or epidemics. To achieve this, the Director of Public Health must carry out the following prescriptions:

Three ambulances are mobilized for each resettlement center to facilitate evacuation to Maillot Hospital in the west and the Eastern Hospital Company. The map ensures precise access routes. Thus, an emergency evacuation system for victims from the disaster area to Maillot Hospital must be implemented, providing the ORSEC device with all possible ambulances.



**Figure 11. Map illustrating the mission of providing healthcare to disaster victims**

#### **e. Provision of Potable Water**

To avoid complications that may arise from the use of tap water, the Water Resources Directorate, specializing in this field, must undertake this mission. Each resettlement center must have four tanks of potable water with a capacity of 10,000 liters each, ensuring water quality control and supply routes.

#### **f. Establishment of Energy Supply**

Since energy is the driving force behind rescue operations, each resettlement center must be equipped with two generators, also utilizing those from the nearest public facilities. Special routes are also reserved for fossil fuel supply (gas, diesel, gasoline, etc.), as shown in Figure 12.

- The gas station (east side)
- The gas station (west side)
- The Civil Protection Directorate in Zemirli.



**Figure 12. Map showing the mission of setting up energy supply**

## 7. Conclusion

The in-depth study based on a likely scenario related to a flood disaster in the locality of Bab El Oued has demonstrated that:

- The urban fabric is physically divided into two parts by Oued Koriche (western part and eastern part).
- The physical division of Bab El Oued by a hazardous watercourse necessitates the installation of structures serving in the emergency plan (logistics bases, hospital, resettlement center, etc.) on both banks of Oued Koriche, to ensure all required missions can be carried out without crossing the hazardous zone (the watercourse).
- The need to create a suitable route system adapted to the natural and human morphology of the urban fabric of Bab El Oued, in order to quickly and effectively manage the situation without being exposed to risk.
- The necessity of a rational deployment of human resources and material assets requisitioned under the emergency plan.

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- [4] *Google Earth + MNT (Digital Terrain Model).*