Arab Remote Sensing and Geographic Information System Organisation

# Break of dams and their impacts on the environment Case of dam DJORF Torba Kenadsa -Bechar Algeria

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**KEYWORDS:** Dams break, Environment, demographic, socio-economic, Torba Kenadsa-Bechar, impact

**ABSTRACT**

A dam breaking is rare, but sometimes is a considerable scale event environmental. Such is of notorious importance which can be in the beginning many damage. To assess the impact this failure, it is necessary to know the extent of the area flowed the valley downstream of the dam as well as the time of arrival of the wave to judge if the safety of human lives.

After the breaking of a dam; an area of high turbulence is formed proceeding the area where the flow is not permanent discontinuity it is a hydraulic phenomenon not raising of the equation of saint-venant.

The front wave height is 1/3 of the height of the dam but it is decreases quickly with flowing distance of the dam. The determination of the characteristics of the wave allows for establish a flood map. The work is completed by using the CASTOR software, which makes the simulation of the dam breaking flood wave possible and to represent it with the maximum impact that affect to the water level, the velocity and time propagation.

**INTRODUCTION AND JUSTIFICATION**

This article has for object the survey of the submersion wave in the case of the rupture of the dam of DJORF TORBA and their impacts on the environment is situated in the wilaya of Bechar, One uses for this survey software developed by the CEMAGRAF and named CASTOR.
The main objectives of the application are:

- To identify the or the scripts possible of rupture of the dam.
- Determination of the features of the propagation wave to the downstream until the point of stop the survey.
- To value the risk in order to establish a card of inondablitée.

**Dam Djore Torba**

DJORF TORBA is a concrete dam used for the creation of a reservoir, with a total capacity of 350 hm3 till the normal coast of the reservoir (699) in order to exploit a highly seasonal flow of oued-GUIRE.

- Type: concrete dam weight
- Oued: Oued Guir
- Height: 37m
- Length: 762 m
- Planning: Sofroten, Frankr,
- Design: Cometra Citra-Bousiron-France
- Construction period: 1965-1968
- Beginning of the works: on octobre 1965
- End of the works: in 1967
- Mise en eau: 1969
- Longitude W 02° 46’ 17’’
- Latitude: N 31° 30’ 38’’
- Initial capacity: 350 hm3
- Estimated Capacity: 296.4 hm3
- Volume: 212.7 hm3
- Filling up rate: 60.8 %

**Feature Detailers of the Djorf Torba Dam**

The Djorf Torba dam has been projected of type dam weight made of classic profile Concrete (fruits 0.05 +0.76 =0.81/1), long of 762 meters, using the whole height of the site and completed of this fact in right strand by:

- A dam borders 200 meters;

The profiles across every section are represented below (25 sections) one hangs:
Section of the dam:

A tray chalky sub horizontal

- An auxiliary disk of length of 60 meters and high of 4 meters.

This dam is implanted in light curve (R=490 meters), but the contacts are not calved.

**The Geometry of the Valley**

The main characteristics of the valley (long and through profiles) have been set from topographic maps with the assistance of GLOBAL MAPPER 11 and GOOGLE EARTH software.

Then, we set the characteristics of each section (the coasts, the tally distances in relation to the level of minor bed center of the oued, and the local slopes of each section.

The local slope (j) from the section (S) is calculated as following:

$j$ = (oued coast of section (S-1))- (oued coast of section (S))

The distance between (S) and (S-1), with S section in the valley and (S-1) the previous section.

The sections have been chosen either on the straight confluence of the oued or the straight inhabited zones or zones with infrastructures, where there is geomorphological change (widening, narrowing) in the valley.

The form of the valley is explained by taking into account through profiles which represent the main variations of geometry.

**Profiles of Sections**

In our application we have taken into consideration 25 sections with the following characteristics:

| Distance (m) | Section | Distance cum (m) | coast (m) | Dénivelée (m) | Slope local |
|---|---|---|---|---|---|
| 0 | Barrage | | 700 | | |
| 3941.0 | Section 1 | 3941.0 | 679,26 | 20,74 | 0.0052 |
| 8741.0 | Section 2 | 12682.0 | 668,9 | 10,36 | 0.00048 |
| 13015.0 | Section 3 | 25679.0 | 676,99 | 8.09 | 0.0048 |
| 17449.0 | Section 4 | 43146.0 | 655,97 | 20.93 | 0.0047 |
| 21442.0 | Section 5 | 64588.0 | 651,09 | 4.88 | 0.0065 |
| 25321.0 | Section 6 | 89909.0 | 644,62 | 6.47 | 0.0017 |
| 29292.0 | Section 7 | 119201.0 | 642,2 | 2.42 | 0.00059 |
| 34171.0 | Section 8 | 153371.0 | 636,93 | 5.27 | 0.0011 |
| 38322.0 | Section 9 | 191694.0 | 627,49 | 9.44 | 0.0023 |
| 47160.0 | Section 10 | 281786.0 | 611,39 | 8.24 | 0.0019 |
| 51600.0 | Section 11 | 333386.0 | 613,39 | -2 | 0.00044 |
| 54450.0 | Section 12 | 387836.0 | 601,17 | 12.22 | 0.0032 |
| 59340.0 | Section 13 | 447176.0 | 597,71 | 3.46 | 0.00089 |
| 64010.0 | Section 14 | 511186.0 | 590 | 7.1 | 0.0015 |
| 67310.0 | Section 15 | 578496.0 | 589,21 | 0.79 | 0.00024 |
| 71500.0 | Section 16 | 649996.0 | 584,61 | 4.6 | 0.0011 |
| 75710.0 | Section 17 | 725706.0 | 581,87 | 2.74 | 0.00065 |
| 79620.0 | Section 18 | 805326.0 | 577,73 | 4.14 | 0.0011 |
| 82720.0 | Section 19 | 888046.0 | 575,82 | 1.91 | 0.00052 |
| 85133.0 | Section 20 | 973179.0 | 571,3 | 4.52 | 0.0011 |
| 88865.0 | Section 21 | 1062044.0 | 568,55 | 2.75 | 0.00066 |
| 92702.0 | Section 22 | 1154746.0 | 566,05 | 2.5 | 0.00065 |
| 96534.0 | Section 23 | 1251280.0 | 561,40 | 4.65 | 0.0012 |
| 100545.0 | Section 24 | 1351825.0 | 559,26 | 2.14 | 0.00054 |
| 103393.0 | Section 25 | 1455218.0 | 557,75 | 1.51 | 0.00053 |

Table 1: the characteristics of each section

**Dam Section**

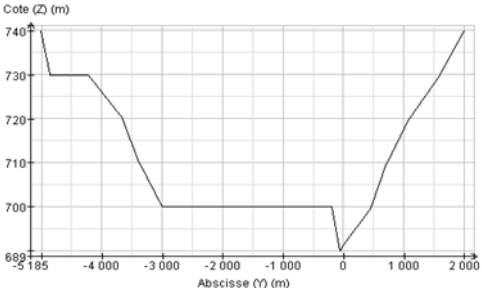



Figure 1: dam profile

**Section 1**

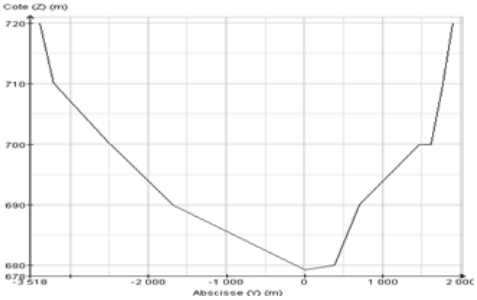



Figure 2: dam profile in section 1

**Section 5**

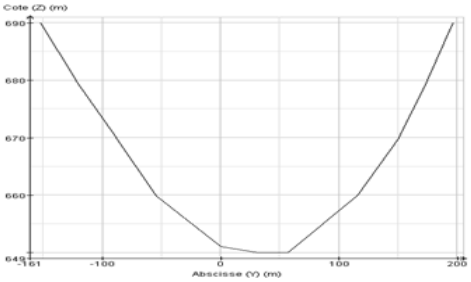



Figure 3: dam profile in section 5

**Section 25**

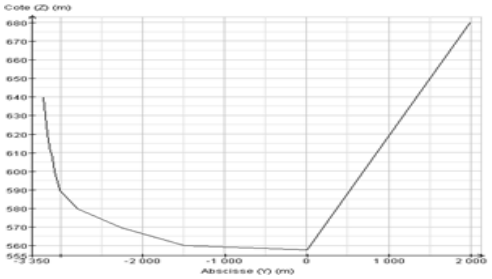



Figure 4: graph showing dam profile in section 25

**Hypothesis of Wave Propagation**

The submersion wave is supposed to propagate itself on initially dry funds in the valley main oued GUIR. This hypothesis justifies itself by the fact that the flows of the wave are distinctly more elevated those of out-flow usual of these rivers

**Criteria of stop of the survey**

The objective fixed to this survey that is not to achieve a complete and just technical survey but rather to know and to master the method of calculation of the propagation of a submersion wave, the criteria of stops calculation of the submersion wave has been fixed arbitrarily to the downstream of dam DJORF TORBA until the city of ABADLA.

**Numeric modeling with CASTOR**

The calculation of the submersion wave in the valley in case of rupture of the dam DJORF TORBA has been achieved by means of the code BEAVER 2.2 developed by the CEMAGREF (Department Management of the Aquatic Surroundings - Unit of Research Hydraulic Hydrology).

**RESULTS**

**Maximum rating and the bottom of the valley**

The figure represents the profile below in long of the maximal rating reached by the wave of submersion in the valley model.

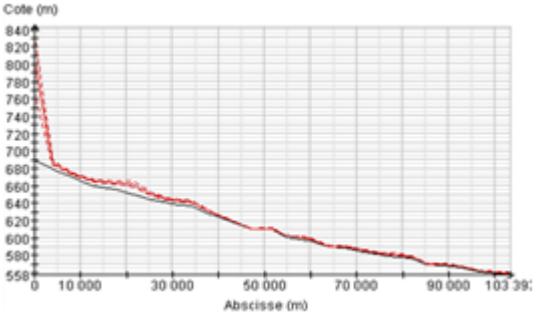



Figure 4: profile in long of the maximum rating of the submersion wave.

We note in this fig that the maximum rating of the submersion wave in the beginning of the valley (the immediate zone) is raised and begin then to decrease progressively to reach the rating of the bottom of the valley to the most distant of the immediate zone.

**The maximum flows (m3/s)**

The flows maxima in every section are represented on the following graph:

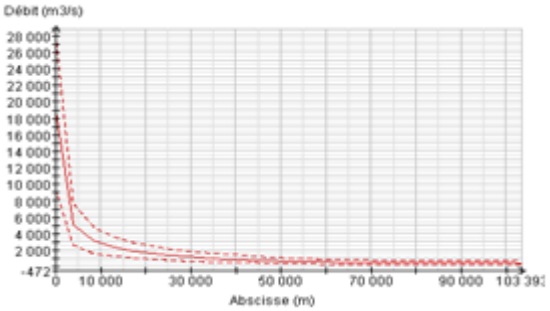



Figure 5: Representation of the flows calculated max and the uncertainty.

We note that, from the face above, that the maximum debit of the submersion wave decreases according to the remoteness of the dam, but not according to the widening or shrinkage of the valley. The debit max to the instant of rupture noted is the order of 18759.0 m3/s, and the minimum debit recorded in the section 25 is the order of 451.0 m3/s.

**The maximal water height**

The height of the maximum submersion wave is represented below in the figure below:

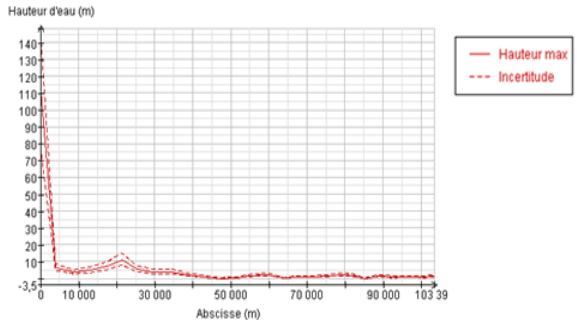



Figure 6: Representation of the maximum height of the submersion wave and the uncertainty

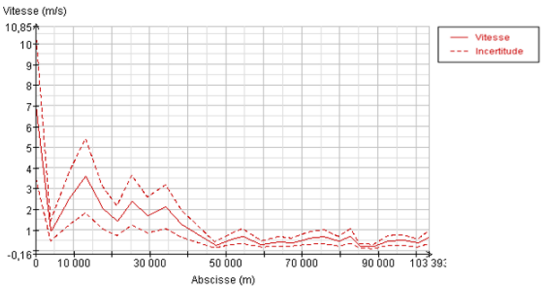
This figure shows us the height of the submersion wave all along the valley.

In beginning of the valley the height is raised because of the important debit recorded in this section, one also notices that the height of the wave varies from a section to the other because of the widening or the shrinkage of section considered.

The maximum height recorded to the level of the section (1) is the order 111.51 m, and the heights minimum were of 0.18m to the level of section (20).

**The maximum speed**

The maximum speed of the wave has shortcoming the valley is illustrated in the face following:

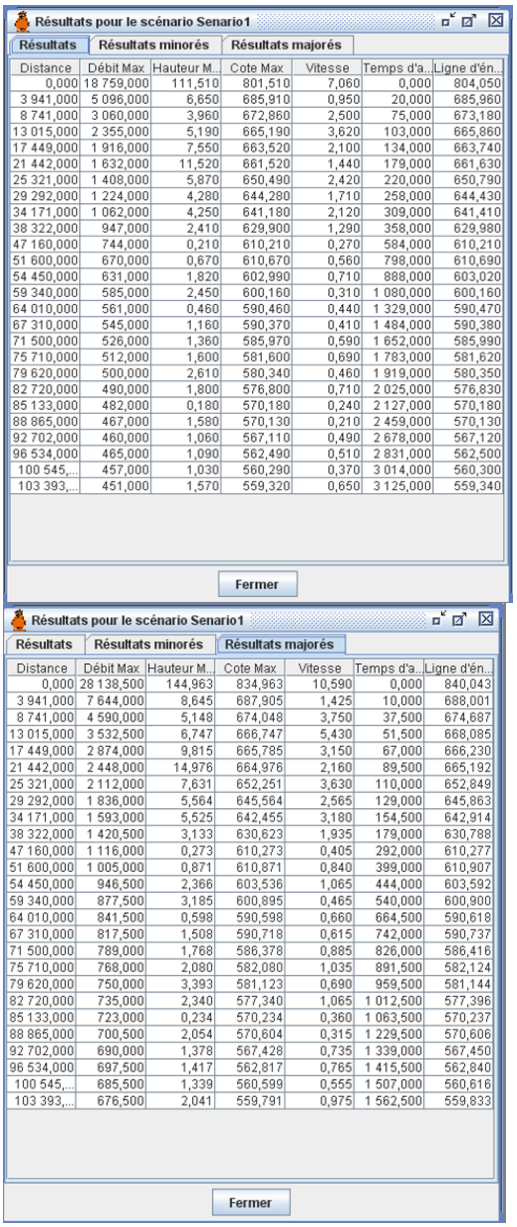



We note that, from this face, the difference between the speeds of the wave to every point of the valley that explains itself by the distance of the point in relation to the dam and the width of the section considered. The speed of the submersion wave changes according to the local slope of the section modélisée.
The noted speed max was the order 7.06 m/s to the level of the section (1), whereas the speed min is of 0.21 m/s. to the level of the section (21).

**The general results of calculations of the submersion wave in the following figure**

We note in this figure that the maximum debit to the instant of rupture is of 18759 m3/s that corresponds to the speed of 7.06m /s, with the expressed debit max by (m3/s), the speed (m/s), the maximum rating (m), the time of arrival (minute).

The heights minima recorded in some section (section 20) are weak in relation to the other because of the width of the sections considered.
The pictures show the results of calculations reduced above and raised recorded in the 25 studied sections


Résultats pour le scénario Senario1

Résultats | Résultats minorés | Résultats majorés

| Distance | Débit Max | Hauteur M... | Cote Max | Vitesse | Temps d'a... | Ligne d'én... |
|---|---|---|---|---|---|---|
| 0,000 | 18 759,000 | 111,510 | 801,510 | 7,060 | 0,000 | 804,050 |
| 3 941,000 | 5 096,000 | 6,650 | 685,910 | 0,950 | 20,000 | 685,960 |
| 8 741,000 | 3 060,000 | 3,960 | 672,860 | 2,500 | 75,000 | 673,180 |
| 13 015,000 | 2 355,000 | 5,190 | 665,190 | 3,620 | 103,000 | 665,860 |
| 17 449,000 | 1 916,000 | 7,550 | 663,520 | 2,100 | 134,000 | 663,740 |
| 21 442,000 | 1 632,000 | 11,520 | 661,520 | 1,440 | 179,000 | 661,630 |
| 25 321,000 | 1 408,000 | 5,870 | 650,490 | 2,420 | 220,000 | 650,790 |
| 29 292,000 | 1 224,000 | 4,280 | 644,280 | 1,710 | 258,000 | 644,430 |
| 34 171,000 | 1 062,000 | 4,250 | 641,180 | 2,120 | 309,000 | 641,410 |
| 38 322,000 | 947,000 | 2,410 | 629,900 | 1,290 | 358,000 | 629,980 |
| 47 160,000 | 744,000 | 0,210 | 610,210 | 0,270 | 584,000 | 610,210 |
| 51 600,000 | 670,000 | 0,670 | 610,670 | 0,560 | 798,000 | 610,690 |
| 54 450,000 | 631,000 | 1,820 | 602,990 | 0,710 | 888,000 | 603,020 |
| 59 340,000 | 585,000 | 2,450 | 600,160 | 0,310 | 1 080,000 | 600,160 |
| 64 010,000 | 561,000 | 0,460 | 590,460 | 0,440 | 1 329,000 | 590,470 |
| 67 310,000 | 545,000 | 1,160 | 590,370 | 0,410 | 1 484,000 | 590,380 |
| 71 500,000 | 526,000 | 1,360 | 585,970 | 0,590 | 1 652,000 | 585,990 |
| 75 710,000 | 512,000 | 1,600 | 581,600 | 0,690 | 1 783,000 | 581,620 |
| 79 620,000 | 500,000 | 2,610 | 580,340 | 0,460 | 1 919,000 | 580,350 |
| 82 720,000 | 490,000 | 1,800 | 576,800 | 0,710 | 2 025,000 | 576,830 |
| 85 133,000 | 482,000 | 0,180 | 570,180 | 0,240 | 2 127,000 | 570,180 |
| 88 865,000 | 467,000 | 1,580 | 570,130 | 0,210 | 2 459,000 | 570,130 |
| 92 702,000 | 460,000 | 1,060 | 567,110 | 0,490 | 2 678,000 | 567,120 |
| 96 534,000 | 465,000 | 1,090 | 562,490 | 0,510 | 2 831,000 | 562,500 |
| 100 545,... | 457,000 | 1,030 | 560,290 | 0,370 | 3 014,000 | 560,300 |
| 103 393,... | 451,000 | 1,570 | 559,320 | 0,650 | 3 125,000 | 559,340 |

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Résultats pour le scénario Senario1

Résultats | Résultats minorés | Résultats majorés

| Distance | Débit Max | Hauteur M... | Cote Max | Vitesse | Temps d'a... | Ligne d'én... |
|---|---|---|---|---|---|---|
| 0,000 | 28 138,500 | 144,963 | 834,963 | 10,590 | 0,000 | 840,043 |
| 3 941,000 | 7 644,000 | 8,645 | 687,905 | 1,425 | 10,000 | 688,001 |
| 8 741,000 | 4 590,000 | 5,148 | 674,048 | 3,750 | 37,500 | 674,687 |
| 13 015,000 | 3 532,500 | 6,747 | 666,747 | 5,430 | 51,500 | 668,085 |
| 17 449,000 | 2 874,000 | 9,815 | 665,785 | 3,150 | 67,000 | 666,230 |
| 21 442,000 | 2 448,000 | 14,976 | 664,976 | 2,160 | 89,500 | 665,192 |
| 25 321,000 | 2 112,000 | 7,631 | 652,251 | 3,630 | 110,000 | 652,849 |
| 29 292,000 | 1 836,000 | 5,564 | 645,564 | 2,565 | 129,000 | 645,863 |
| 34 171,000 | 1 593,000 | 5,525 | 642,455 | 3,180 | 154,500 | 642,914 |
| 38 322,000 | 1 420,500 | 3,133 | 630,623 | 1,935 | 179,000 | 630,788 |
| 47 160,000 | 1 116,000 | 0,273 | 610,273 | 0,405 | 292,000 | 610,277 |
| 51 600,000 | 1 005,000 | 0,871 | 610,871 | 0,840 | 399,000 | 610,907 |
| 54 450,000 | 946,500 | 2,366 | 603,536 | 1,065 | 444,000 | 603,592 |
| 59 340,000 | 877,500 | 3,185 | 600,895 | 0,465 | 540,000 | 600,900 |
| 64 010,000 | 841,500 | 0,598 | 590,598 | 0,660 | 664,500 | 590,618 |
| 67 310,000 | 817,500 | 1,508 | 590,718 | 0,615 | 742,000 | 590,737 |
| 71 500,000 | 789,000 | 1,768 | 586,378 | 0,885 | 826,000 | 586,416 |
| 75 710,000 | 768,000 | 2,080 | 582,080 | 1,035 | 891,500 | 582,124 |
| 79 620,000 | 750,000 | 3,393 | 581,123 | 0,690 | 959,500 | 581,144 |
| 82 720,000 | 735,000 | 2,340 | 577,340 | 1,065 | 1 012,500 | 577,396 |
| 85 133,000 | 723,000 | 0,234 | 570,234 | 0,360 | 1 063,500 | 570,237 |
| 88 865,000 | 700,500 | 2,054 | 570,604 | 0,315 | 1 229,500 | 570,606 |
| 92 702,000 | 690,000 | 1,378 | 567,428 | 0,735 | 1 339,000 | 567,450 |
| 96 534,000 | 697,500 | 1,417 | 562,817 | 0,765 | 1 415,500 | 562,840 |
| 100 545,... | 685,500 | 1,339 | 560,599 | 0,555 | 1 507,000 | 560,616 |
| 103 393,... | 676,500 | 2,041 | 559,791 | 0,975 | 1 562,500 | 559,833 |

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Figure 7 & 8: output of results

The profiles across the most characteristic of modeling the zone, the evolution of the rating of the water level in every section is retailed below:

**Dam Profile**

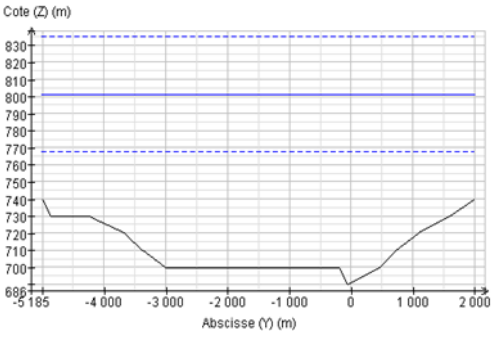

Figure 9: The profiles across the most characteristic of the modeling zone.

**Section 1**

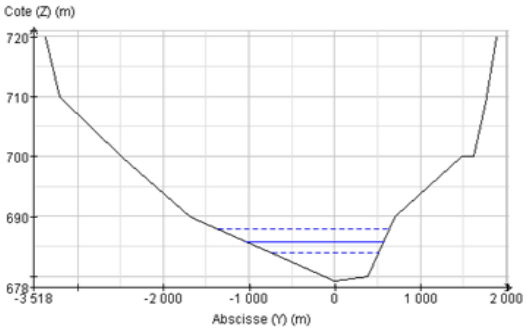


Figure 10: The profiles across the most characteristic of the modeling zone, in Dam section 1

**Section 25**

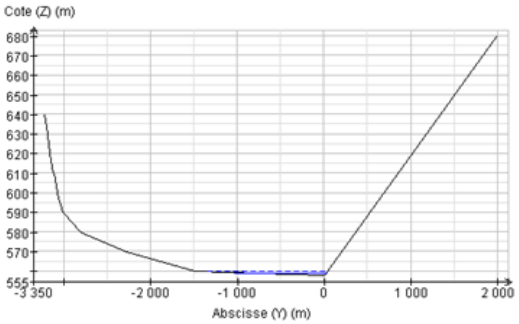


Figure 11: The profiles across the most characteristic of the modeling zone, in Dam section 25

**Interpretation of the result**

From these results, one represents the zones threatened by the wave of submersion (one recalls that the limit of flooding is the point of intersection between the line of energy and the natural land) on a card little is called the card of flooding that would result from a rupture of the dam. This card determines, what will be the features of the submersion wave in all point of the valley:

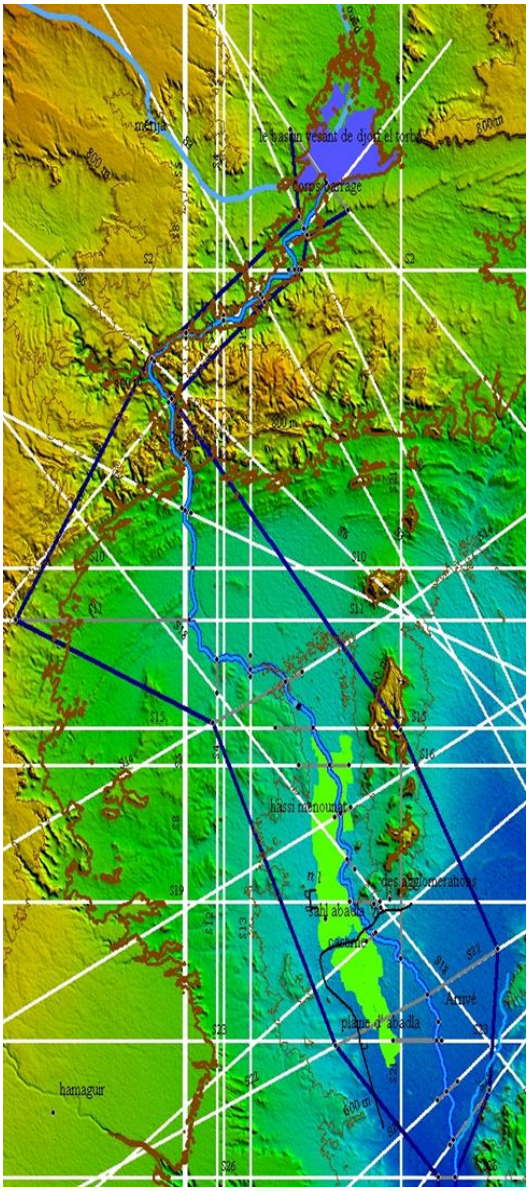


Figure 12: representation of zones threatned by the wave submersion

The time of propagation or passage of the wave, the stakes and the points sensible. This card is represented below:

The cards of the propagation times and ascendancy of the wave front (the card floods) :
The limit of surface flooded swallows the dam Djorf Torba:

**THE FINAL FLOODING CARD**
**The Consequences**

According to the gotten results, just after the rupture of the dam, one will observe an abrupt rise of the water level on sound quoted downstream.

We estimated the surface flooded to 105506 hectares.

And there is what the rise in the water level will make after 2 days on this region:

- After 1652 minutes: The inhabitants of Hassi menounate with their goods tightened shattered and the part superior of the plain of Abadla..
- After 1919 minutes: Guir Lotfi and a big part of the plain.
- After 2025 minutes: The agglomeration of Abadla, the barrack and RN6 will be wiped out.
- After 2838 minutes: Macharaa Houari Boumabiane

In end numbers it of the damages tightened counted by thousand.

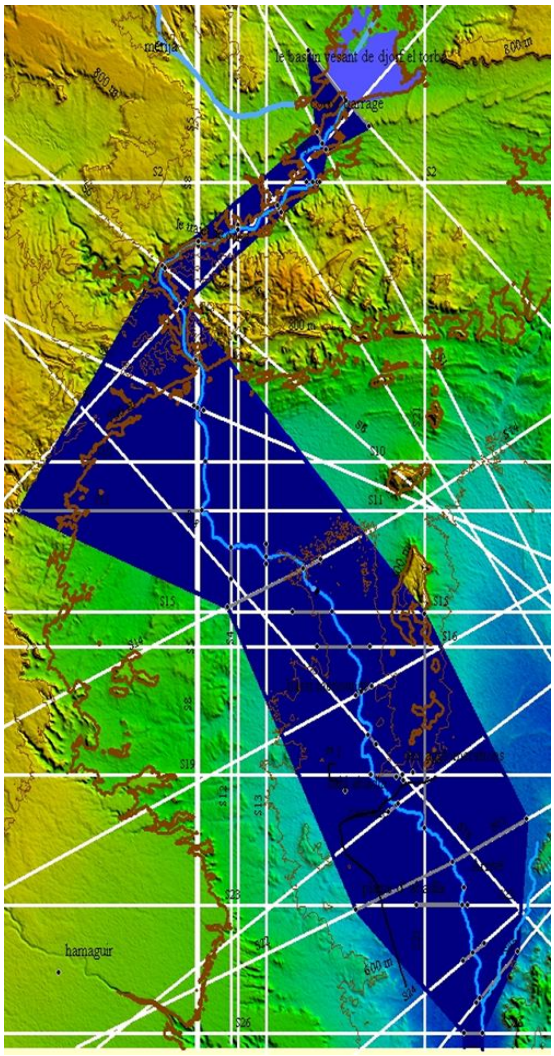


Figure 13: results gained after Dam break

**CONCLUSIONS**

To avoid that such a disaster occurs, the means to put in .over intervene to several stages of life project: at the time of the studies, of the construction, of the exploitation.

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