

4th International workshop on Hydrological Extremes.
15-17, Septembre 2011, Cosenza, Italy.

Is the reinforcement of Algiers stormwater drainage network sufficient enough to protect the city towards extreme rainfall events?/

Est-ce que le renforcement du réseau de drainage des eaux pluviales d'Alger est suffisant pour protéger la ville contre des événements pluvieux extrêmes ?

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Outline

- Introduction
- Presentation of the study area
- Presentation of the new stormwater drainage system.
- Assessment methodology of the new Stormwater duct.
 - IDF Curves.
 - Synthetic hyetograph.
 - The SCS Rainfall-Runoff Model.
- Hydrodynamic simulation for 100yr Return period design storm.
- Conclusion.



- Presentation of the study area

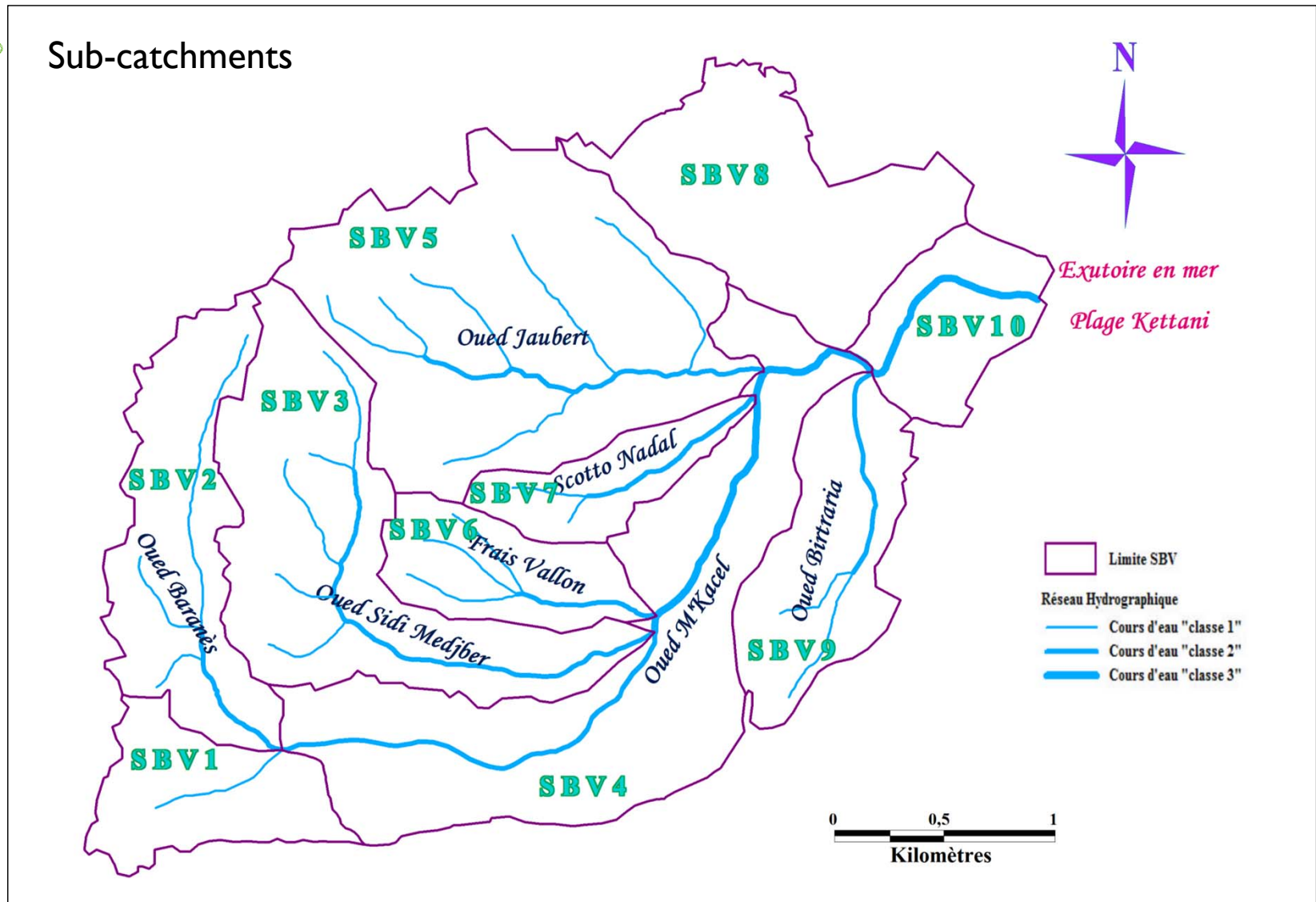
- Bab el Oued is located in the west of Algiers.
- 240,000 Residents.
- In the Oued Mkacel Catchment, $A = 753$ hectares.
- Maximum Elevation : 380m.
- Minimum Elevation: Sea level
- Constituted of 10 subcatchments: Barranes, Sidi Medjber, Frais Vallon, Oued Koriche, Scotto-Nadal, and Jaubert...
- Global time of concentration: 12 minutes.
- Slope varying from 5 to 19%
- Hydrological length of the global catchment: 4.5 Km.

- Presentation of the study area

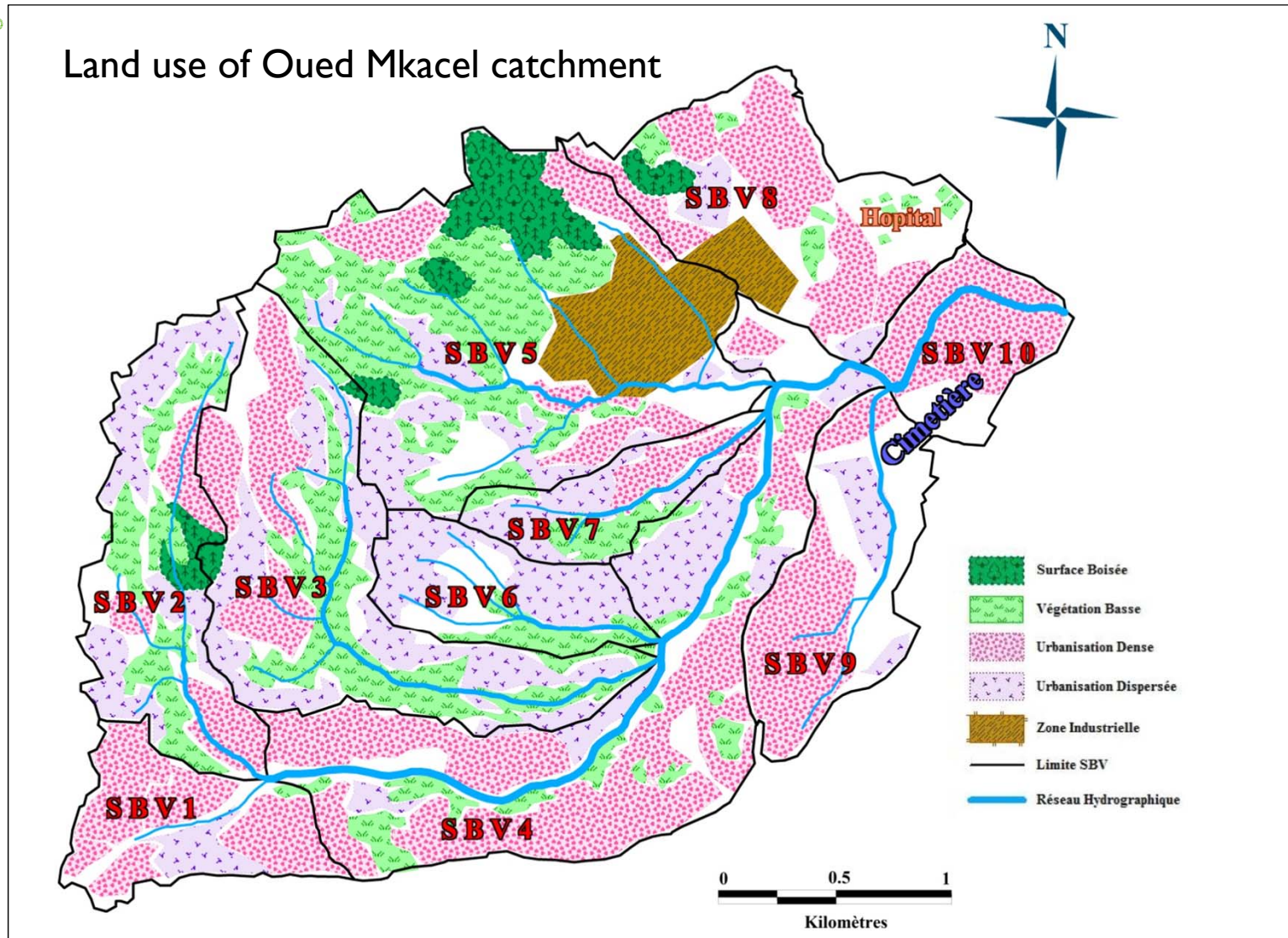


Panoramic view of Oued Mkacel catchment (Bab el Oued)

- Presentation of the study area

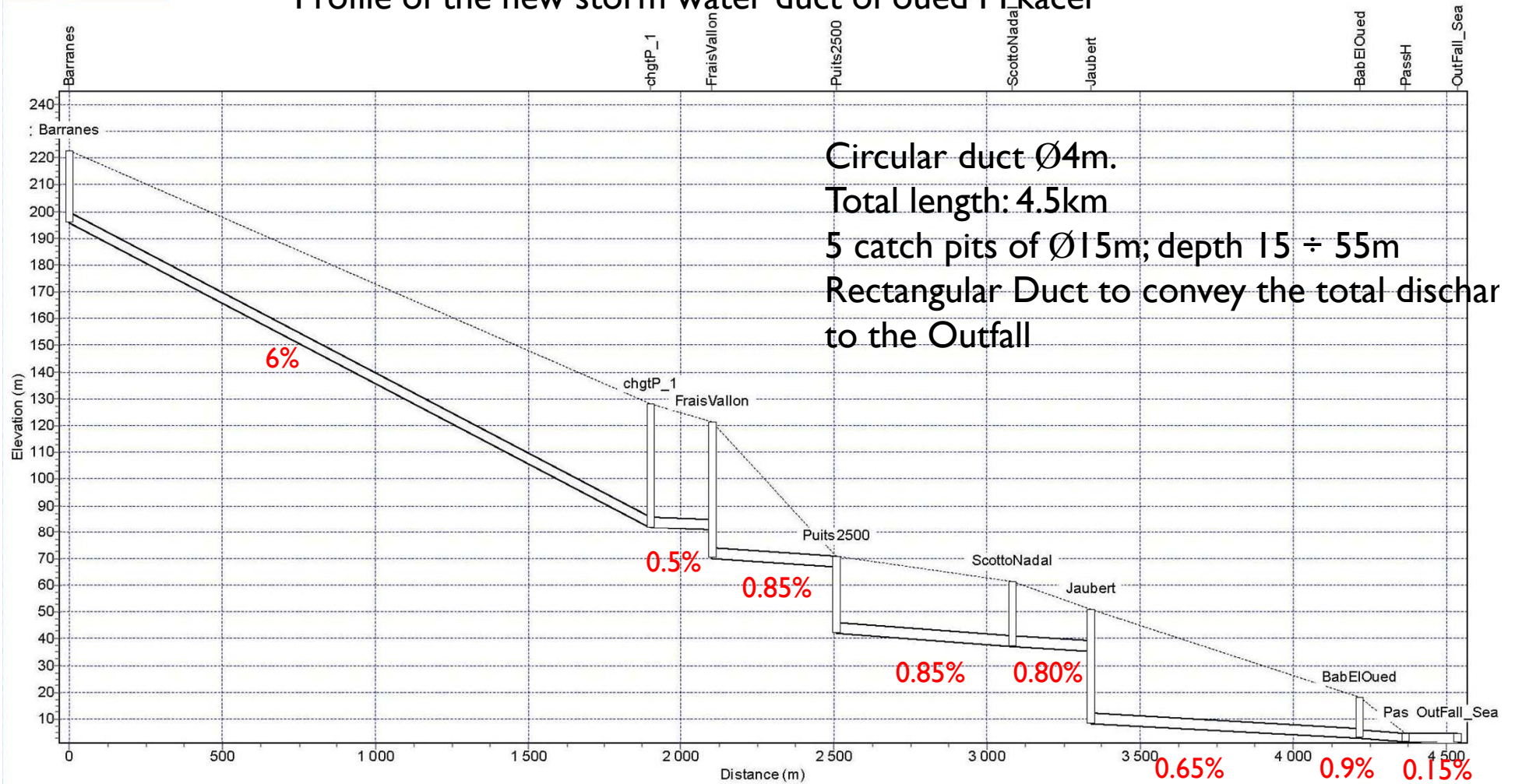


- Presentation of the study area



- Presentation of the new stormwater drainage system.

Profile of the new storm water duct of oued M'kacel

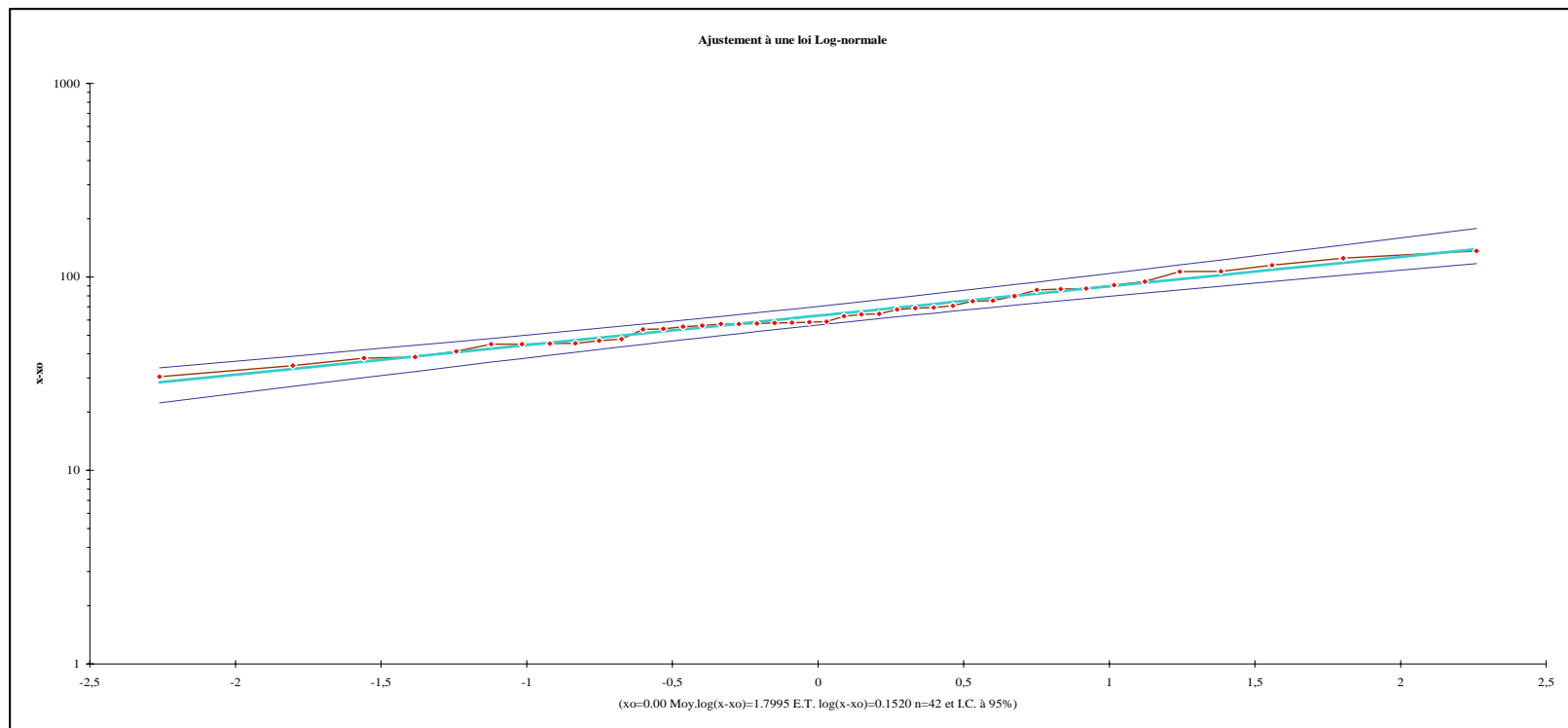


- Assessment methodology of the new Stormwater duct.
 - IDF Curves.
 - Synthetic hyetograph as design storm.
 - The SCS Rainfall-Runoff Model.

- Assessment methodology of the new Stormwater duct.
 - IDF Curves construction.
 - Rainfall recording raingauge unavailable.
 - Rainfall raingauge: available over 42 years (daily)
 - Log-Normal PDF gives the best fit to daily annual maximum rainfall.
 - Simple model for daily rainfall disaggregation.
 - Empirical construction of IDF curves (Montana Model)

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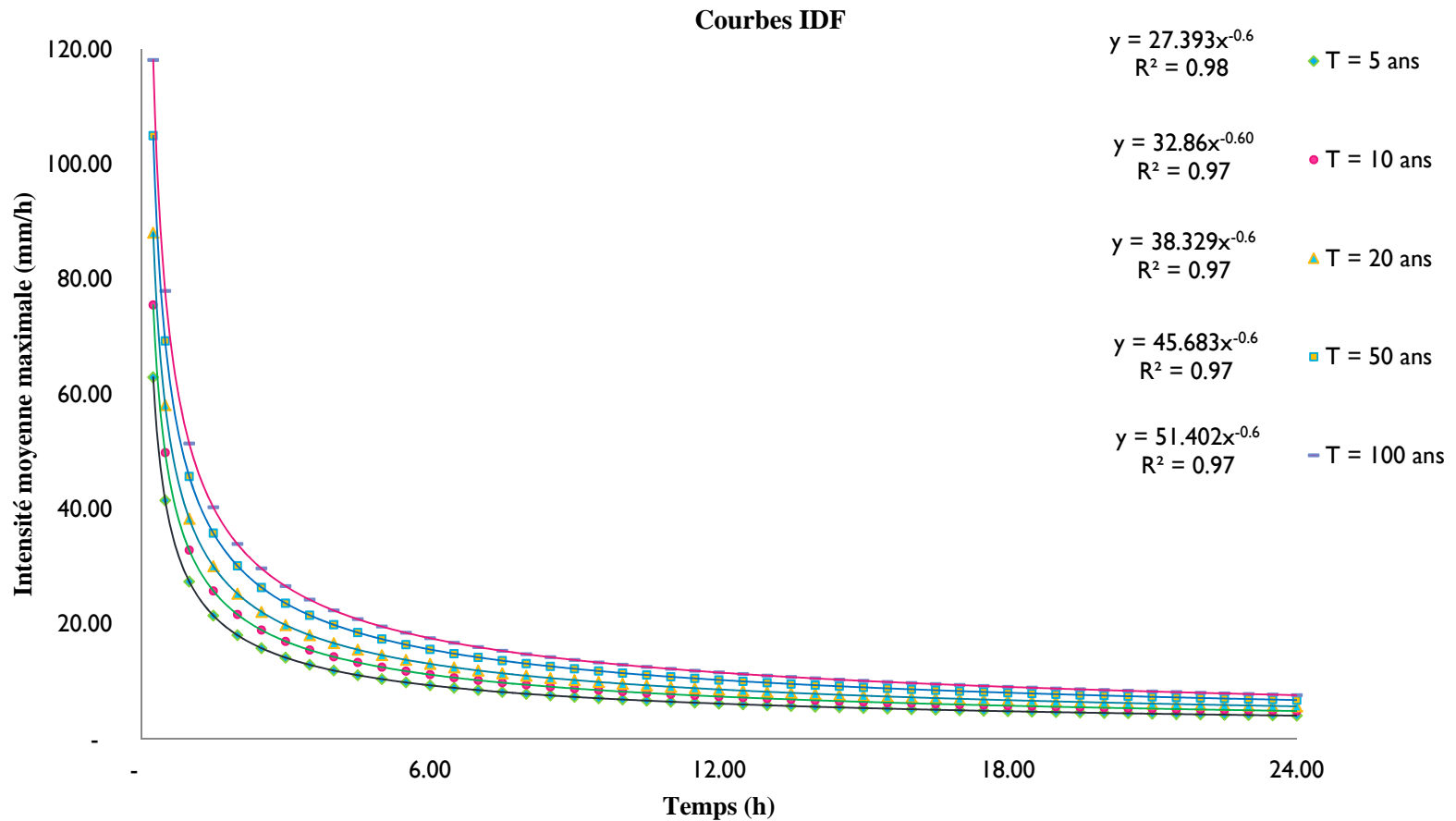
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- $P_{d,T}$: Rainfall amount for a given duration d and return period T .
- P_{amdr} : Annual maximum daily rainfall for a given return period T .
- d : aggregation duration.
- b : Montana coefficient. $b = 0.4$ (Body K., ANRH)

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IDF Curves for Bouzereah Station



- Assessment methodology of the new Stormwater duct.

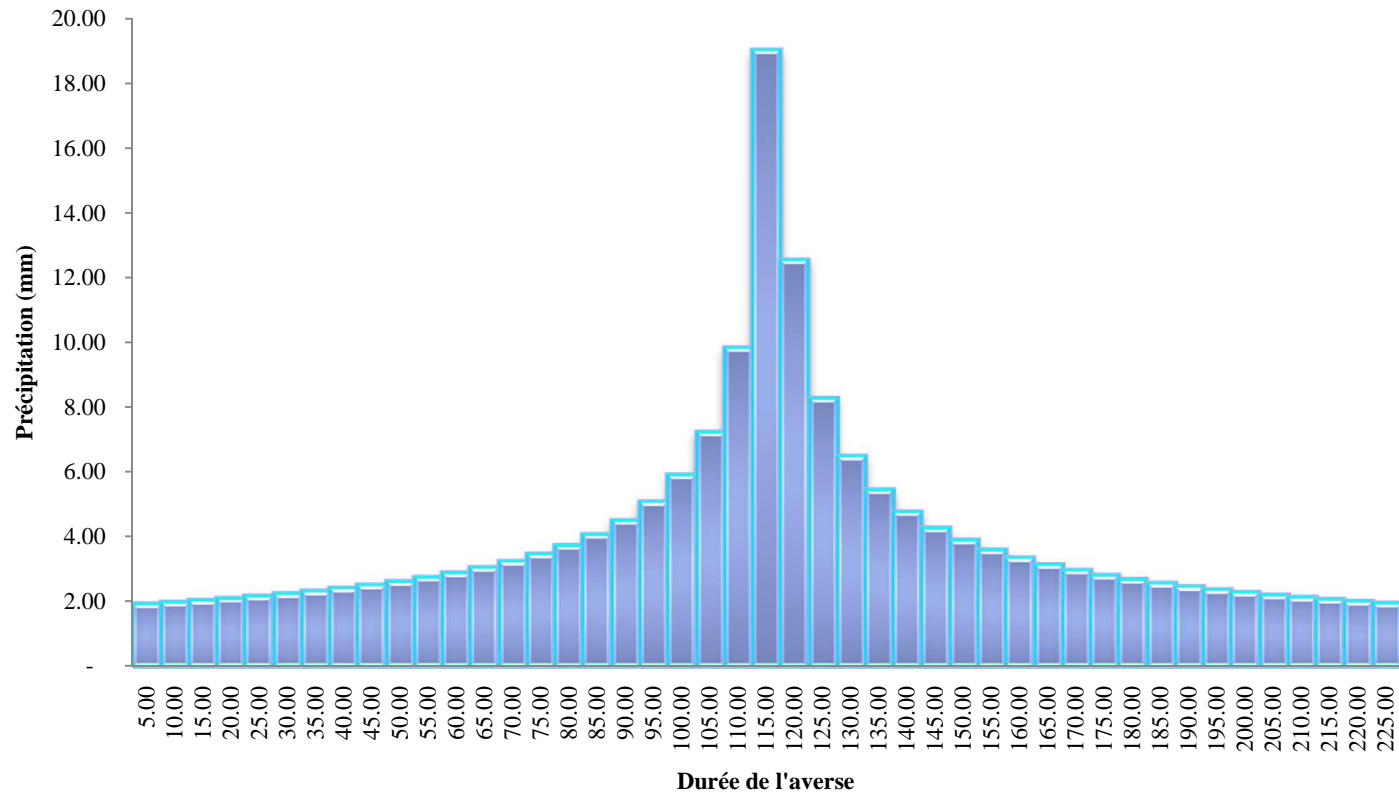
Synthetic hyetograph as design storm

- Algiers Water administration (DRHEE) gives a standard of an event with return period of 100 year for urban drainage network.
- Synthetic hyetograph is constructed by applying the alternating block method
- Rainfall duration: 240minutes.
- Time interval: 5 minutes

- Assessment methodology of the new Stormwater duct.

Synthetic hyetograph: return period of 100yr

Pluie de projet de type blocs alternés T=100ans



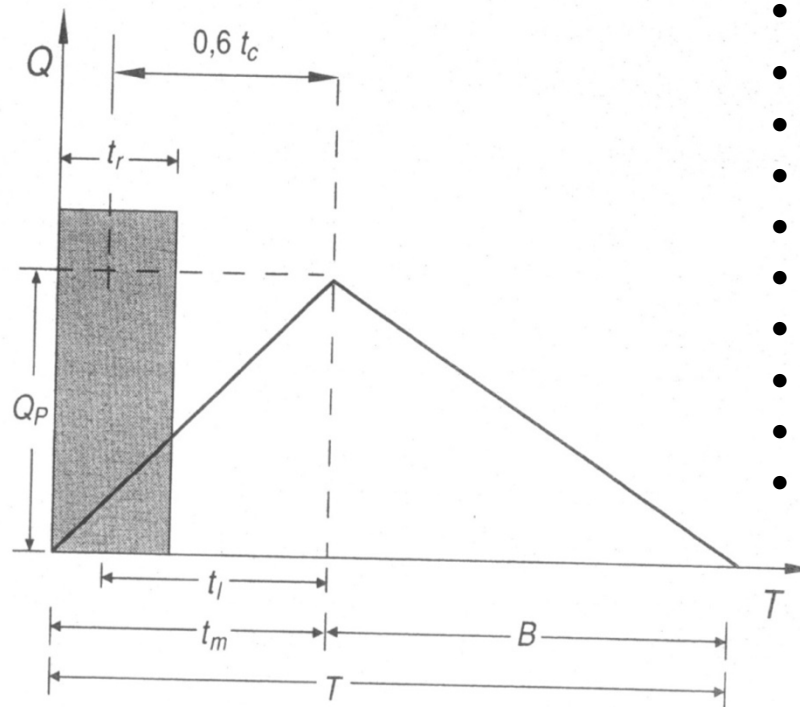
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- The SCS Rainfall-Runoff Model

- SCS-CN procedure as production function.
 - Taking into account Runoff from, connected impervious, unconnected impervious and pervious areas.
 - Logical area grouping: weighted Curve Number CN (Hydrodynamics of the soil)
- SCS triangular hydrograph to estimate peak discharge.

- Assessment methodology of the new Stormwater duct.

SCS triangular hydrograph to estimate peak discharge.



- t_c : time of concentration (Kirpich formula).
- t_l : lag time: $t_l = 0.6 t_c$.
- t_r : Critical rainfall duration: 120mins.
- t_m : Rise time (to the peak).
- B : time of recession.
- T : Base time. $T = t_m + B$
- V : runoff volume. $V = Q \cdot A_i$
- Q : runoff.
- A_i : Subcatchment Area.
- Q_{pi} : Peak discharge. $Q_{pi} = 2V/T$

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The SCS Rainfall-Runoff Model: Results

Sub Catchment	Qp (m ³ /s) 100yr design storm
Chevaley	12.89
Barranes	15.25
Sidi Medjber	23.41
Frais vallon	9.77
Oued Koriche 1	28.75
Oued Koriche 2	2.17
Oued Koriche 3	10.83
Oued Koriche 4	2.15
Oued Koriche 5	3.19
Scotto-Nadal	7.02
Jaubert	40.13
Bab el Oued	22.10
Total (Oued Mkacel)	177.68

- Assessment methodology of the new Stormwater duct.

The SCS Rainfall-Runoff Model: Results

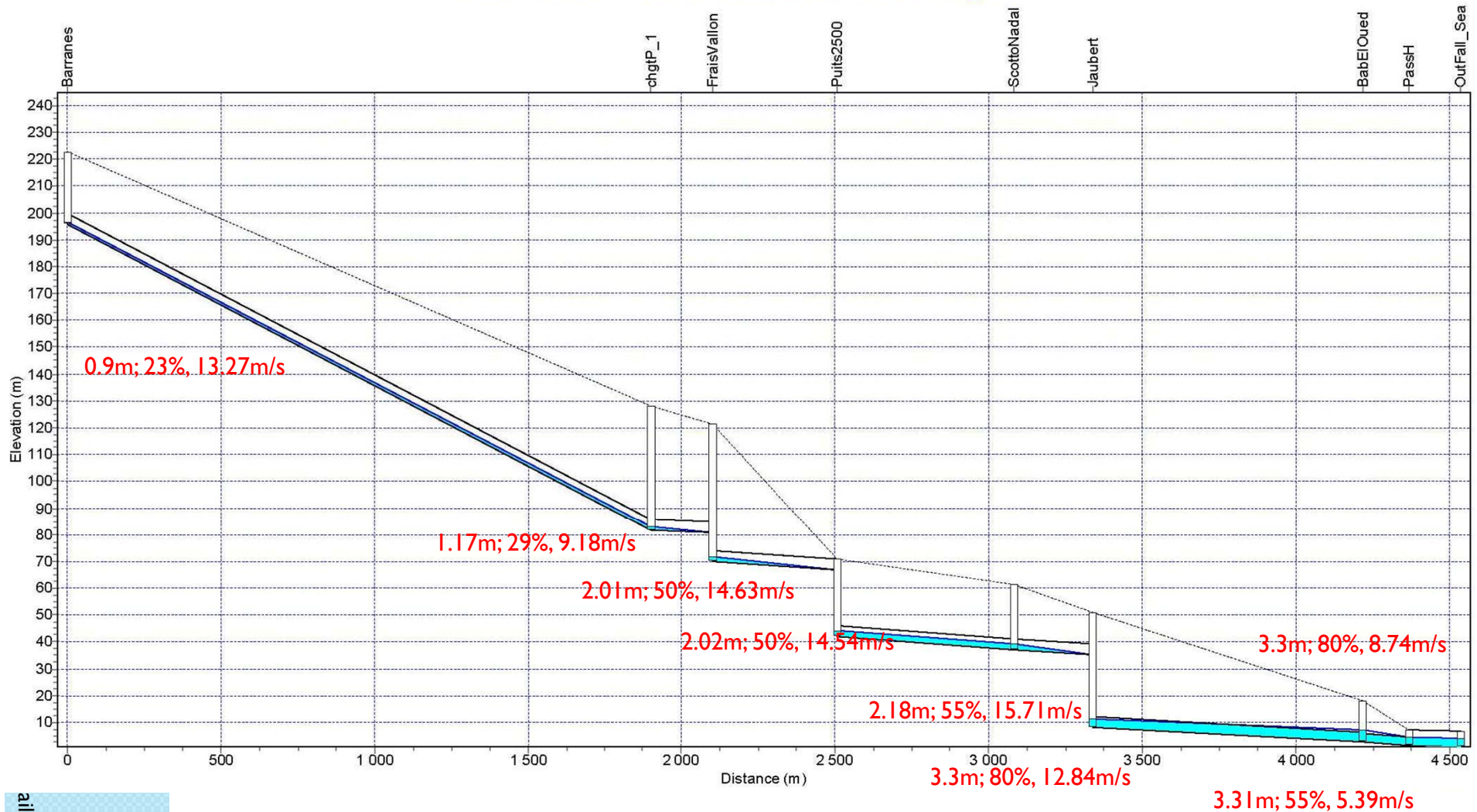
Conduit	Qp (m ³ /s) 100yr design storm
Barranes to Frais vallon	28.15
Frais Vallon to Scotto Nadal	92.25
Scotto nadal - Jaubert	110.10
Jaubert - Bab el Oued	152.39
Bab el Oued -Outfall	177.68
Barranes to Frais vallon	28.15
Frais Vallon to Scotto Nadal	92.25
Scotto nadal to Jaubert	110.10
Jaubert to Bab el Oued	152.39
Bab el Oued to Outfall	177.68

Hydrodynamic simulation for 100yr Return period design storm

- Hydrodynamic simulation is performed by the SWMM 5.1 (water surface elevation, velocity...)
- Dynamic wave routing method is applied.

Hydrodynamic simulation for 100yr Return period design storm

Water Elevation Profile: Node Barranes - OutFall_Sea



- Conclusion.

- The new storm water duct is able to convey safely the discharge of Oued Mkacel catchment (Bab el oued).
- The design storm used to check capacity of conveying is equivalent to the event of November 9, 2001.
- Only 30% of the conveying capacity is used in the up stream, This is due to the requirement to have a single diameter (Single \emptyset of TBM) .
- Whether correct operating (No obstruction) conditions are guaranteed, disaster such as that November 9, 2001 will never happen again. Hope so
- The Algerian authority have spend 60millons euros to prevent from flooding for only one catchment of Algiers.

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Thank you!