

Impacts of extreme rainfall to transport networks



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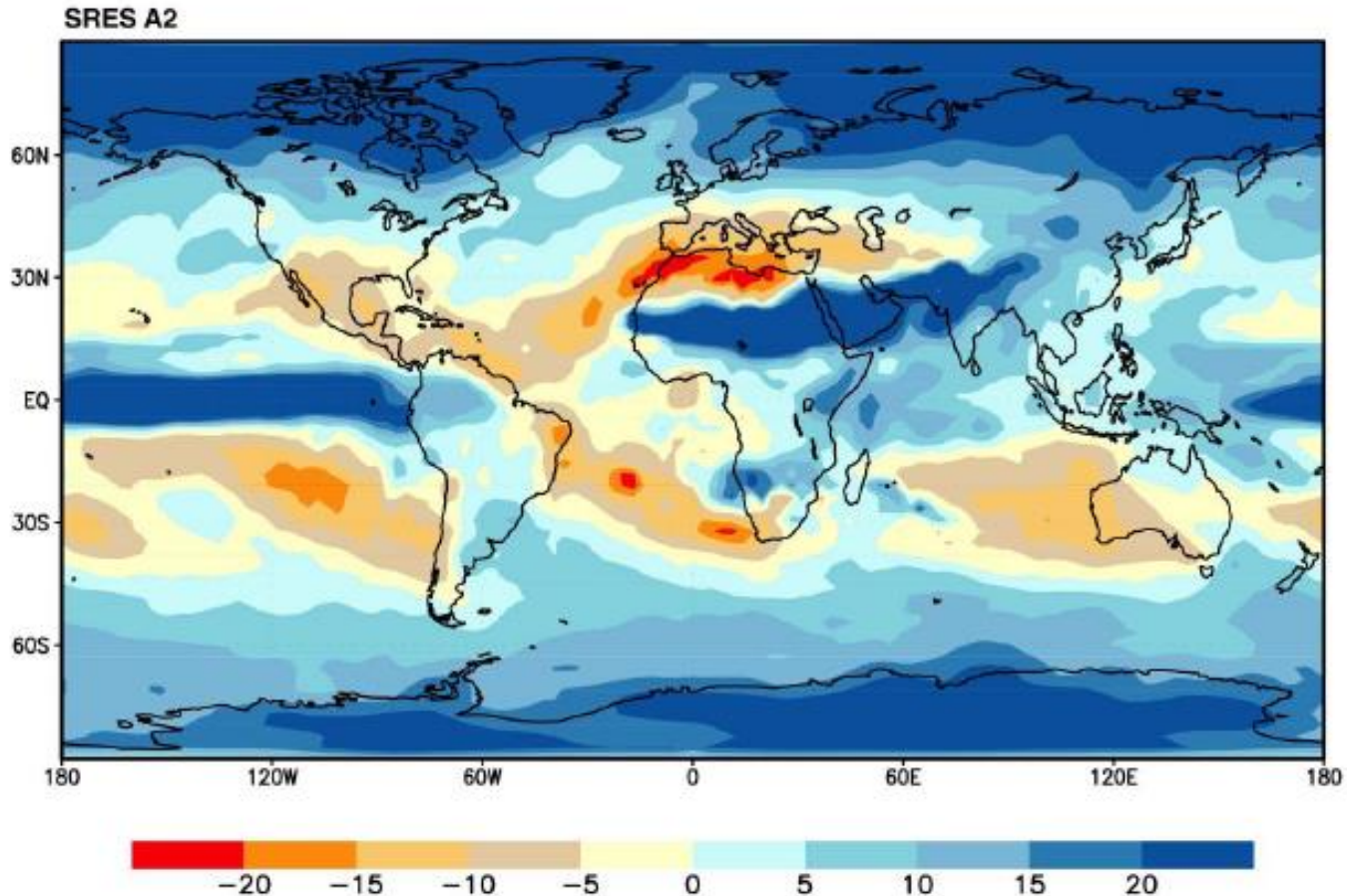
Group of Experts meeting on
“Climate Change Impacts and Adaptation for transport networks and nodes”
Geneva, 11-12 April, 2016

“Impacts of extreme rainfall on transport networks”

- Flooding of highways is one of the most severe problems that we have to deal with in order to ensure the operational requirements of transport networks.
- Climate change impacts on water resources, at all stages of the hydrological circle, are amongst the most important ones.
- One of the goals of the hydraulic design of highways is to prevent extreme rainfall events to result to flooding

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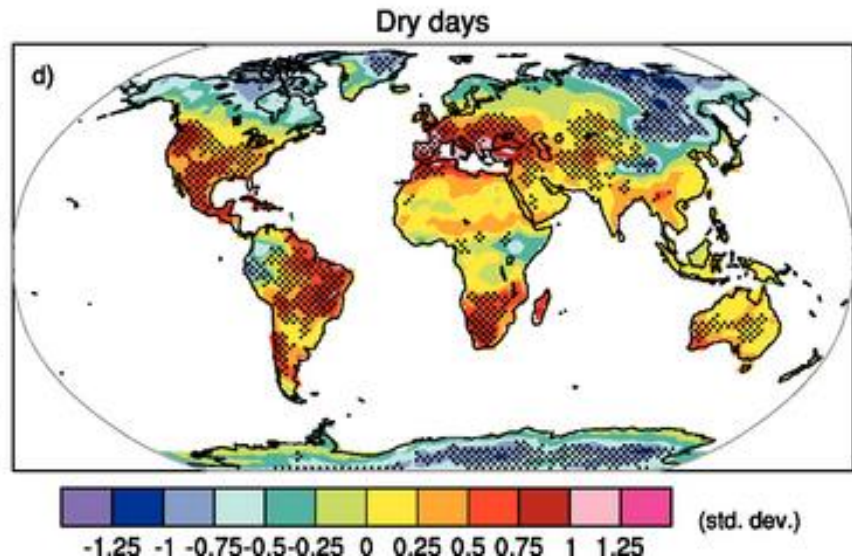
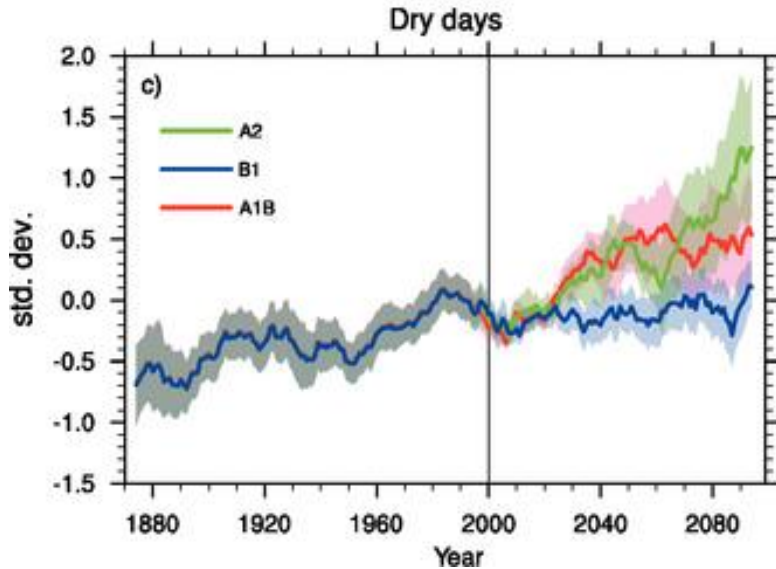
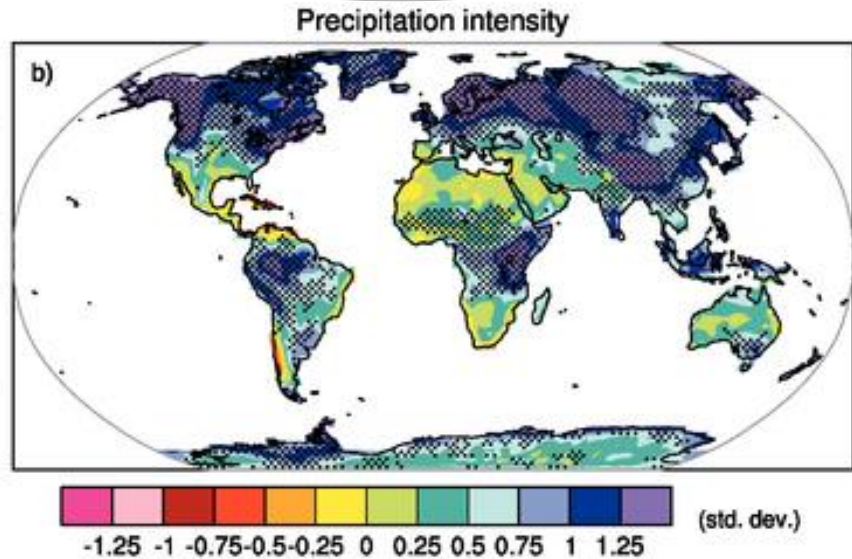
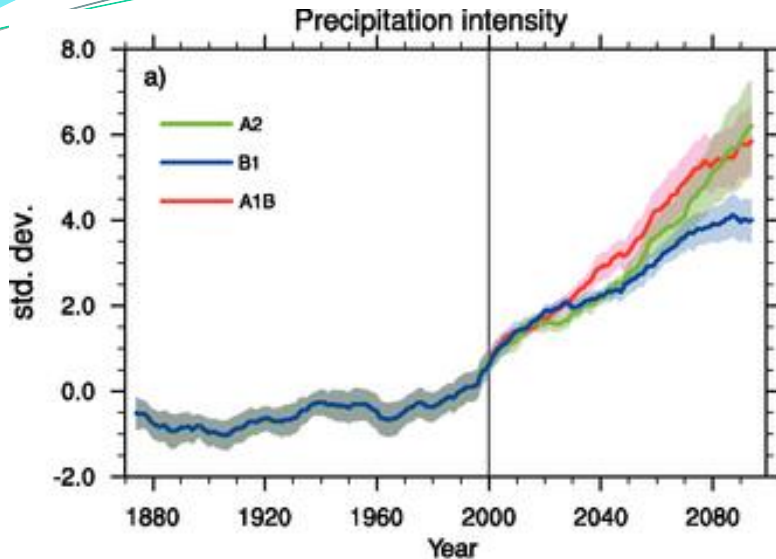
Mean changes in rainfall (%) for the SRES A1B scenario for the period 2080-2099 compared to the period 1980-1999.



IPCC Fourth Assessment Report: Climate Change 2007

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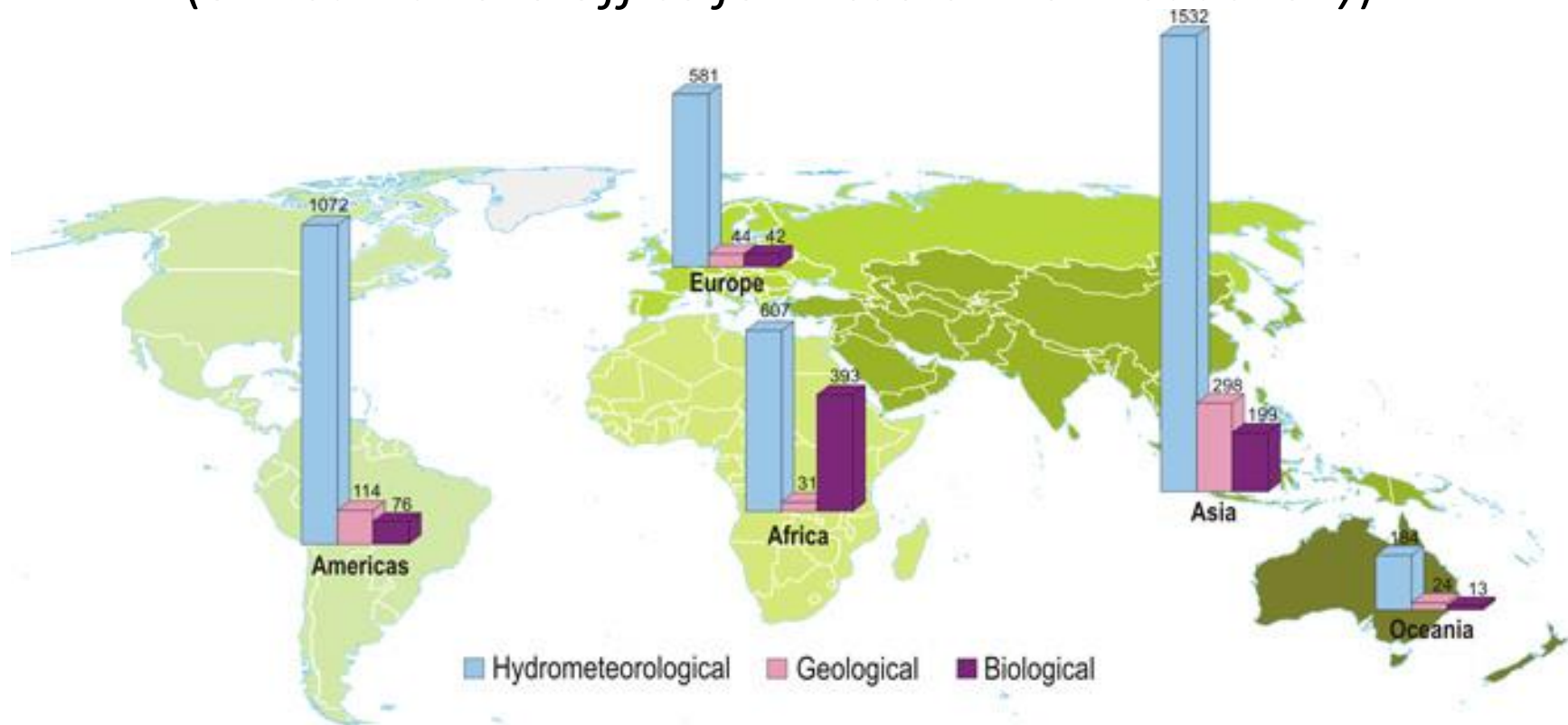


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Distribution of natural disasters per continent based to their origin for the period 1991-2005.
(United Nations Office for Disaster Risk Reduction)



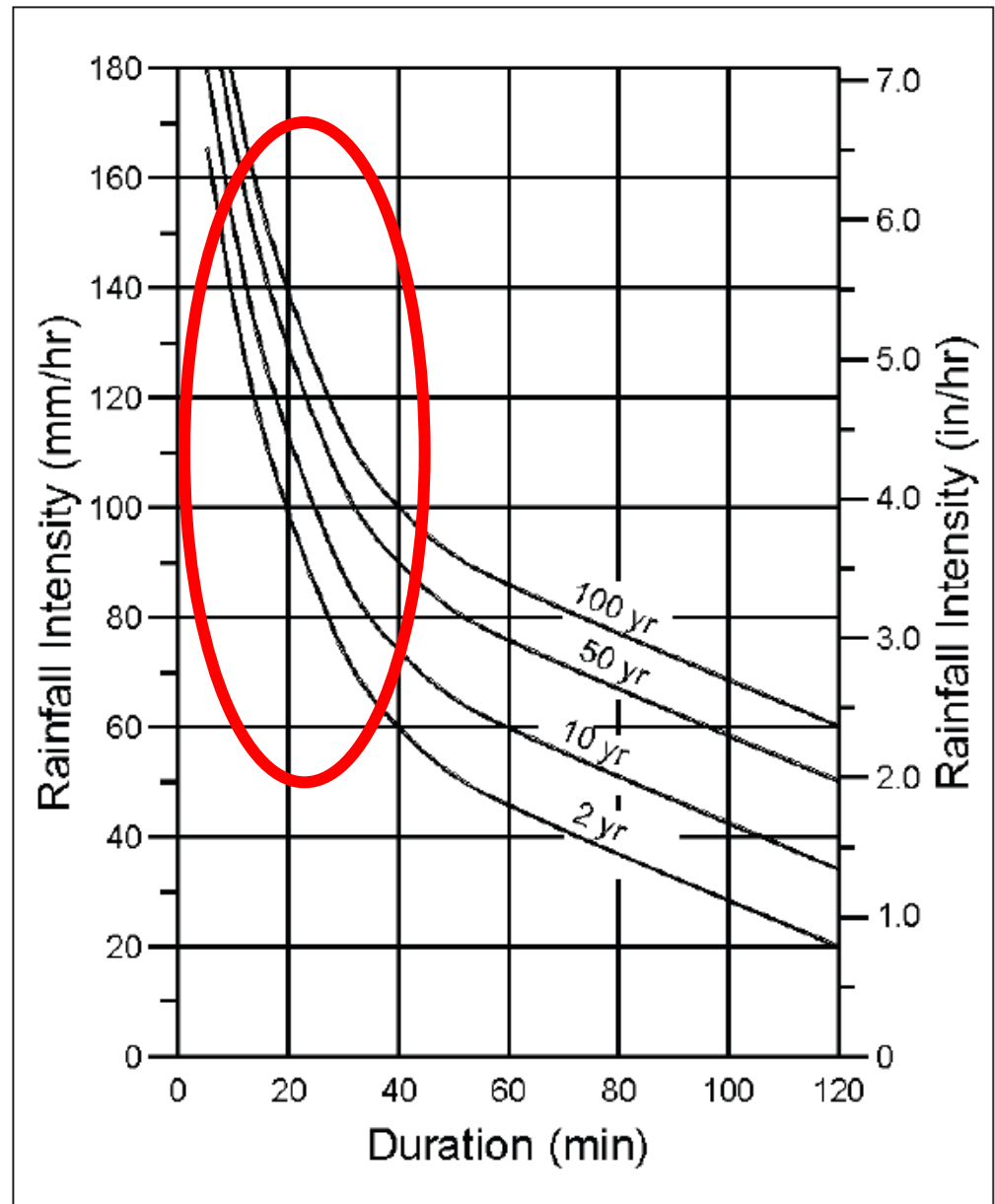
Rainfall Intensity-Duration
curve per return period



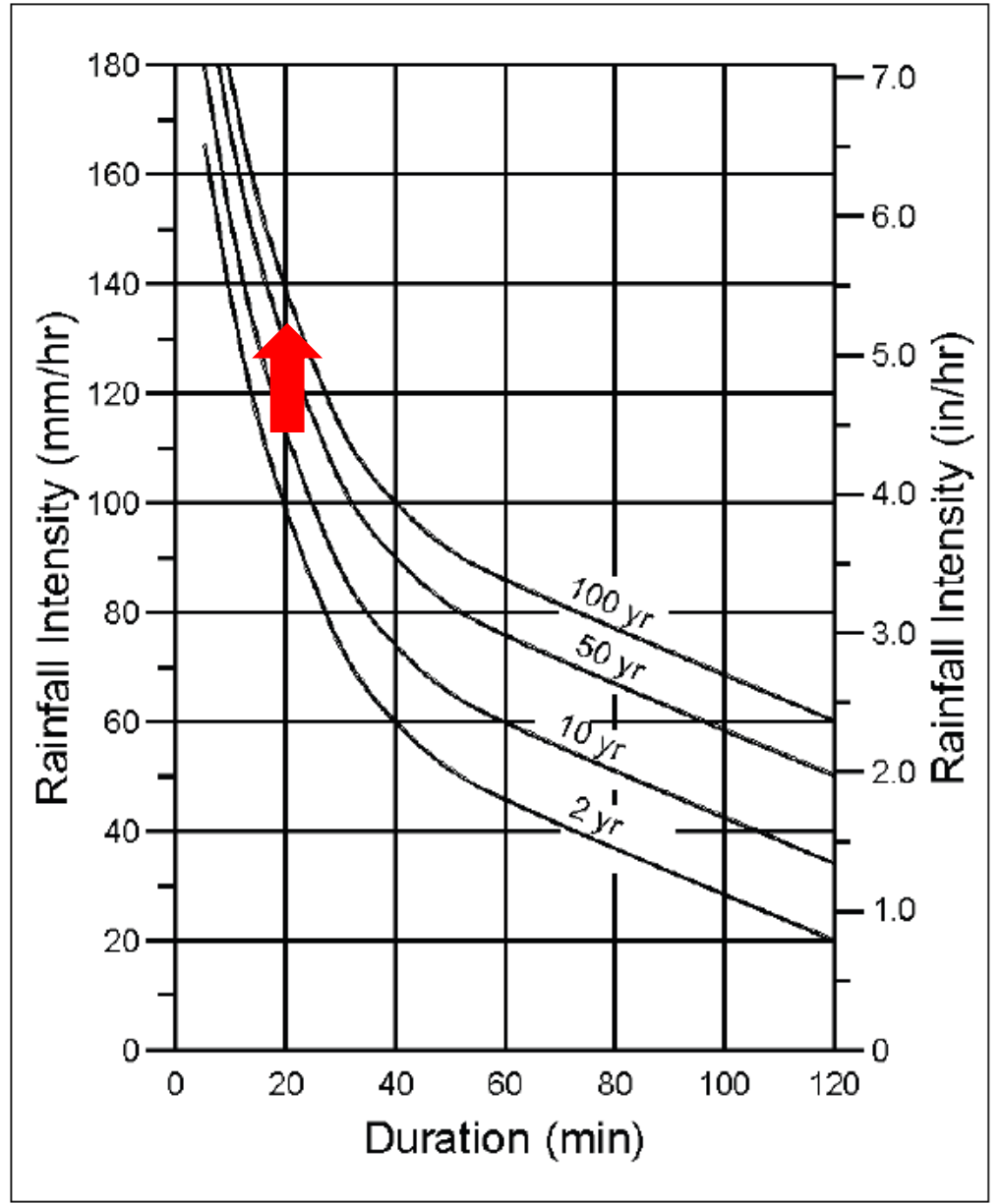
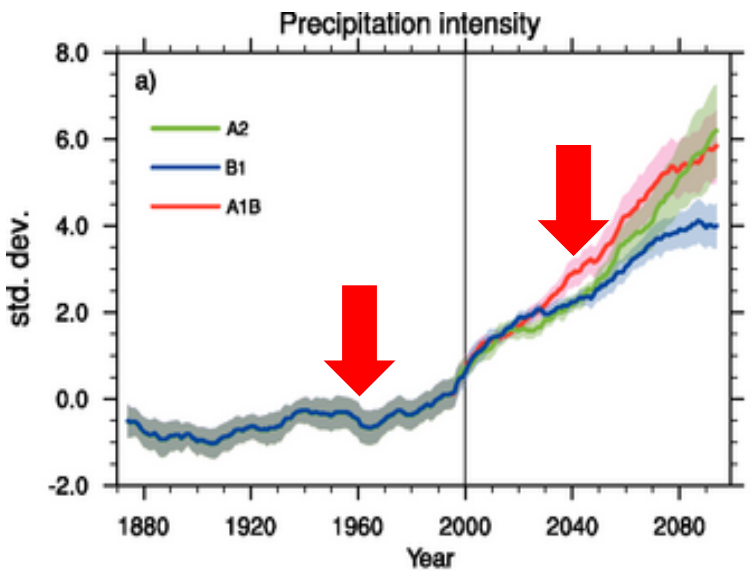
U.S. Department
of Transportation

**Federal Highway
Administration**

URBAN DRAINAGE DESIGN MANUAL



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Floods directive 60/2007/EC

“on the assessment and management of flood risks”

- Pluvial
- Fluvial
- Groundwater
- Sea

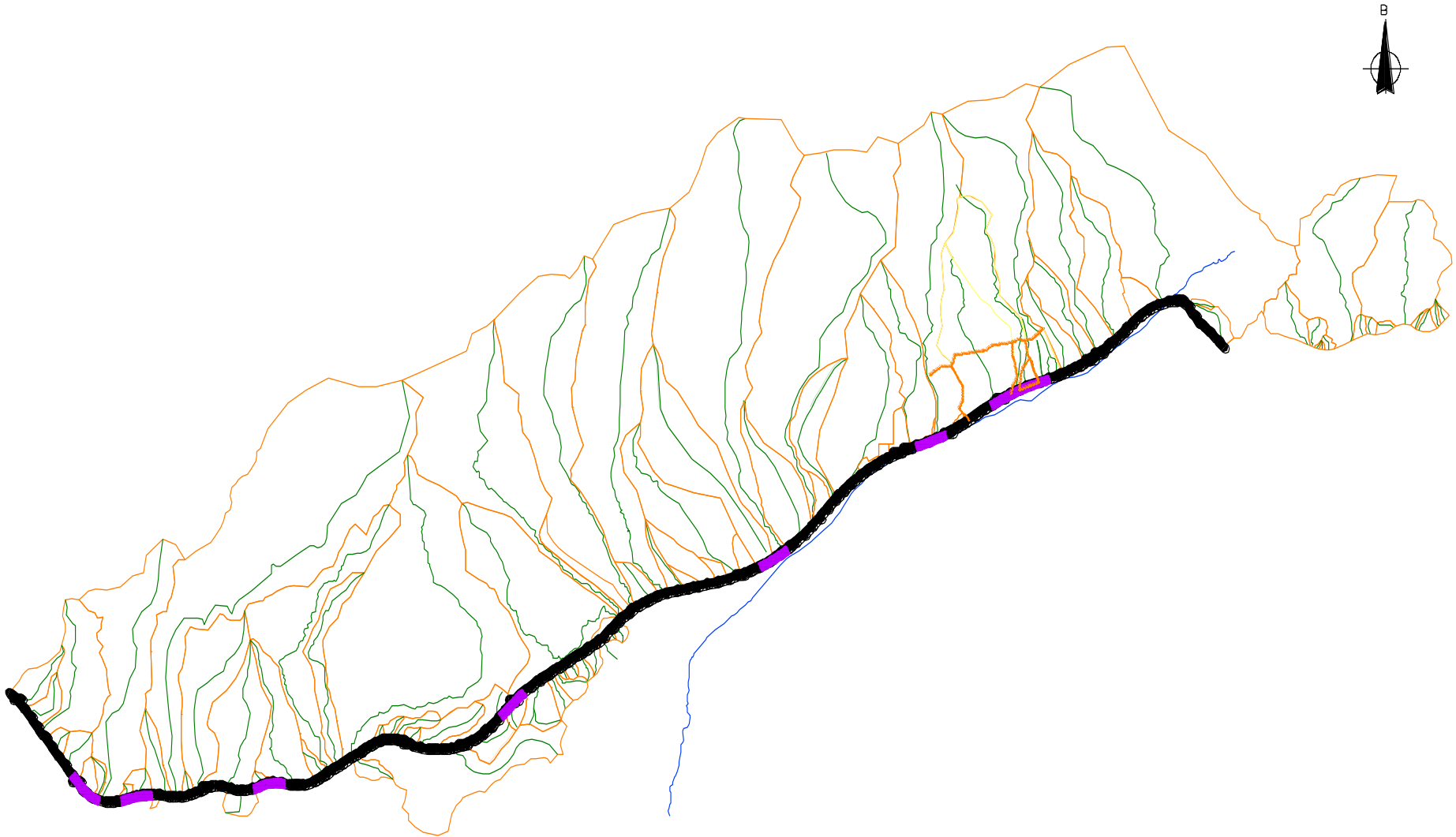


Floods directive 60/2007/EC

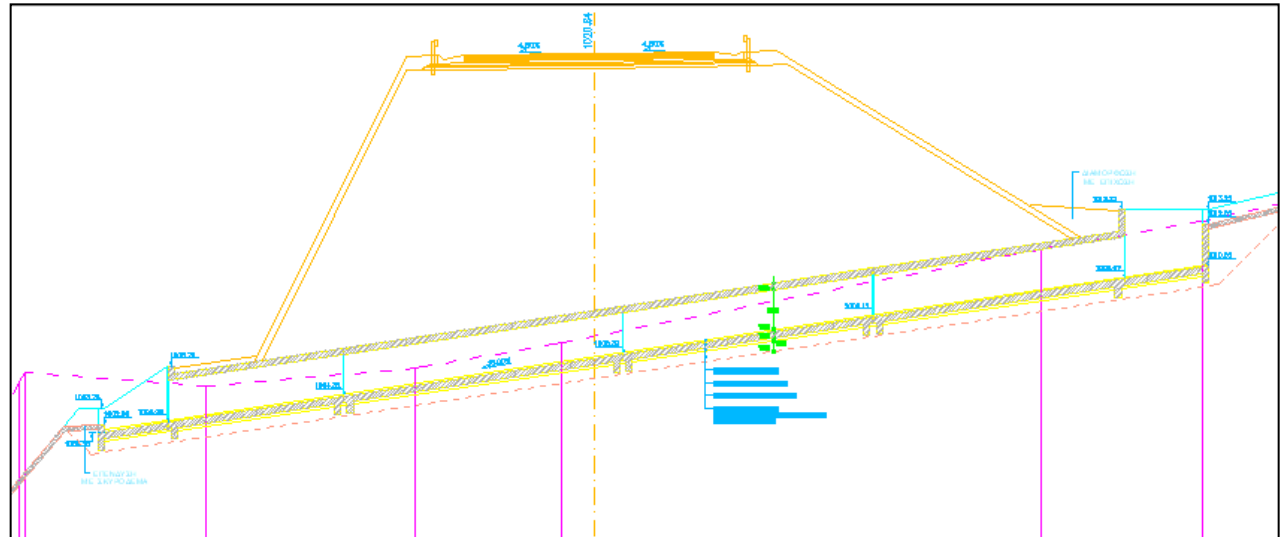
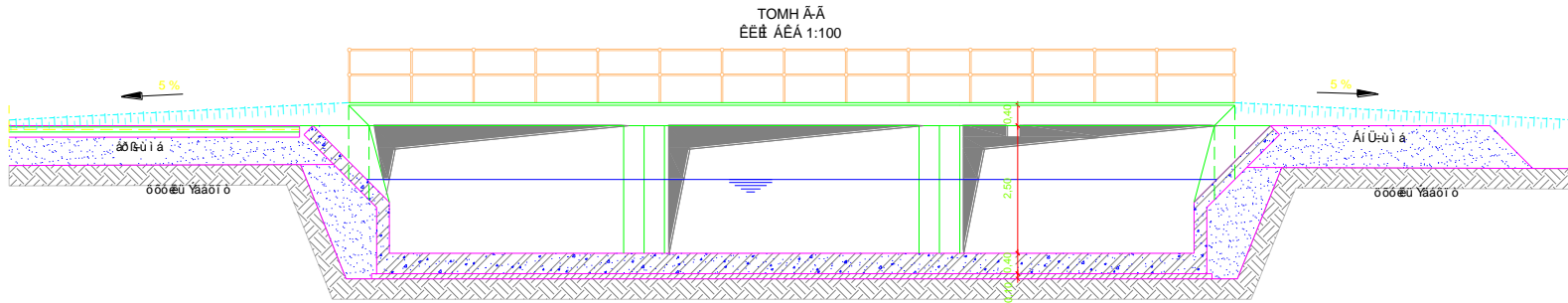
“on the assessment and management of flood risks”

- Floods are natural phenomena which cannot be prevented. However, some human activities (such as increasing human settlements and economic assets in floodplains and the reduction of the natural water retention by land use) and climate change contribute to an increase in the likelihood and adverse impacts of flood events.
- Flood hazard: The possibility of occurrence of a flood event in a specific place corresponding to a given return period.
- Flood risk: the combination of the probability of a flood event and of the potential adverse consequences for human health, the environment, cultural heritage and economic activity associated with a flood event.

Surface outflows: External watersheds



Surface outflows: External watersheds Bridges and culverts



Problems: Floods that cannot be prevented



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Problems: Insufficient design under extreme conditions



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Problems: Reduction of water retention by change in land uses



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Problems: Inadequate maintenance



Problems: Soil erosion and solid transport

Rainfall, and the surface runoff which may result from rainfall, can produce soil erosion.

If the soil is saturated, or if the rainfall rate is greater than the rate at which water can infiltrate into the soil, surface runoff occurs.

If the runoff has sufficient flow energy, it will transport loosened soil particles (sediment) down the slope.

Factors affecting soil erosion:

- The amount and intensity of precipitation
- The composition, moisture, and compaction of soil
- Vegetative cover
- Topography



Climate change - Studies on soil erosion suggest that increased rainfall amounts and intensities will lead to greater rates of soil erosion.

Problems: Soil erosion and solid transport



Problems: Soil erosion and solid transport



Conclusions:

- Since we can not alter flood hazard we need to take the necessary measures to minimize flood risk.
- We need to rethink the methodology we apply for the design of hydraulic works, to include estimations of the impacts of climate changes

Thank you for your attention.

