Flood Mitigation by Forestry

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RheinlandPfalz

- Flood generation
- Identification of runoff processes
- Precautionary measures for flood mitigation
- Efficiency of decentralized retention measures
- Conclusions

Landesforsten
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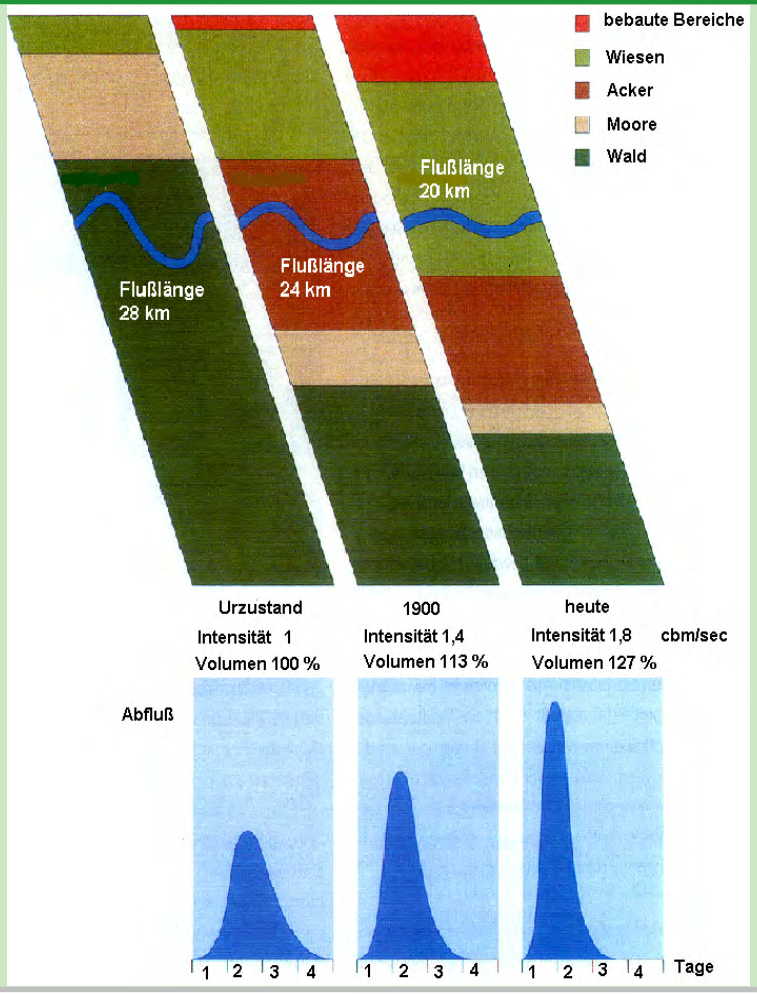
Runoff and flood are natural processes …

… water needs enough space to spread …

Flash floods can become very dangerous, and it is expected that they will happen in a higher frequency in future with a changing climate.

They occur in shortest time – and efficient protection measures are rarely to find.

A changing landuse with decreasing forest areas, shortening river courses, increasing intensified agriculture and settlement areas accelerates and increases the runoff and overland flow.



In consequence protection against floods and flash floods should start when runoff occurs.

It is important to know how and where runoff is generated (hot spots of flood generation) before implementing water retention measures

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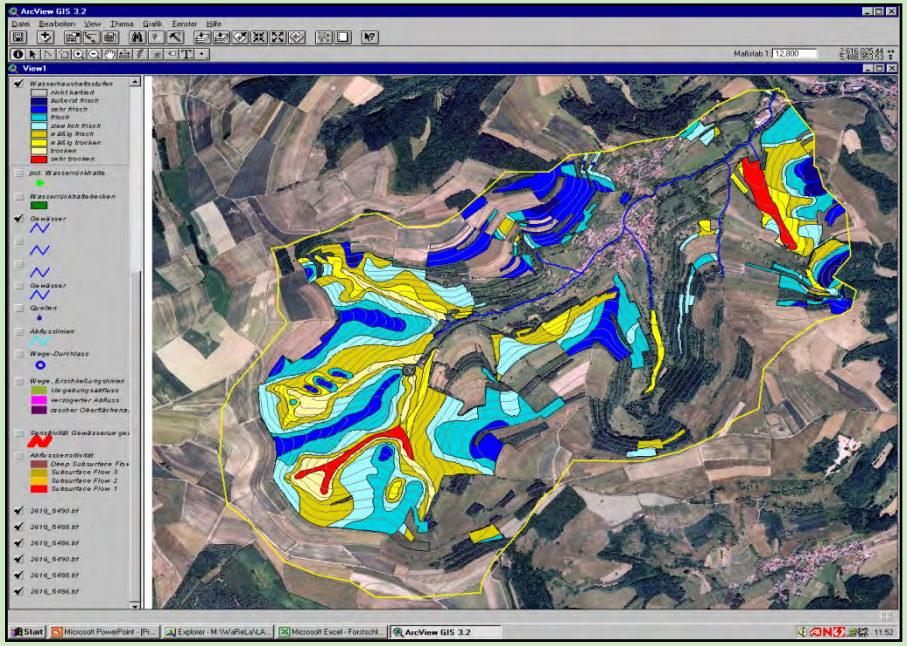
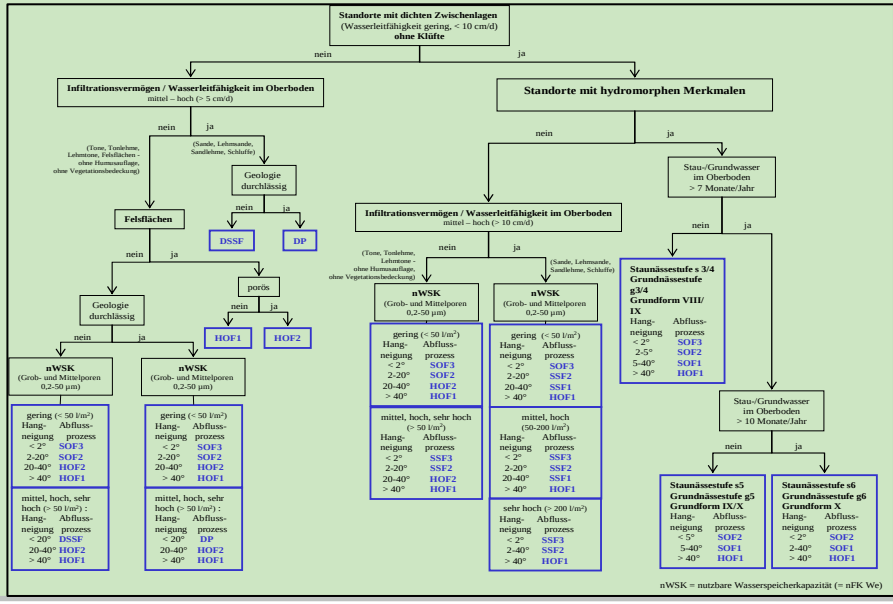
Hot spots of flood generation…

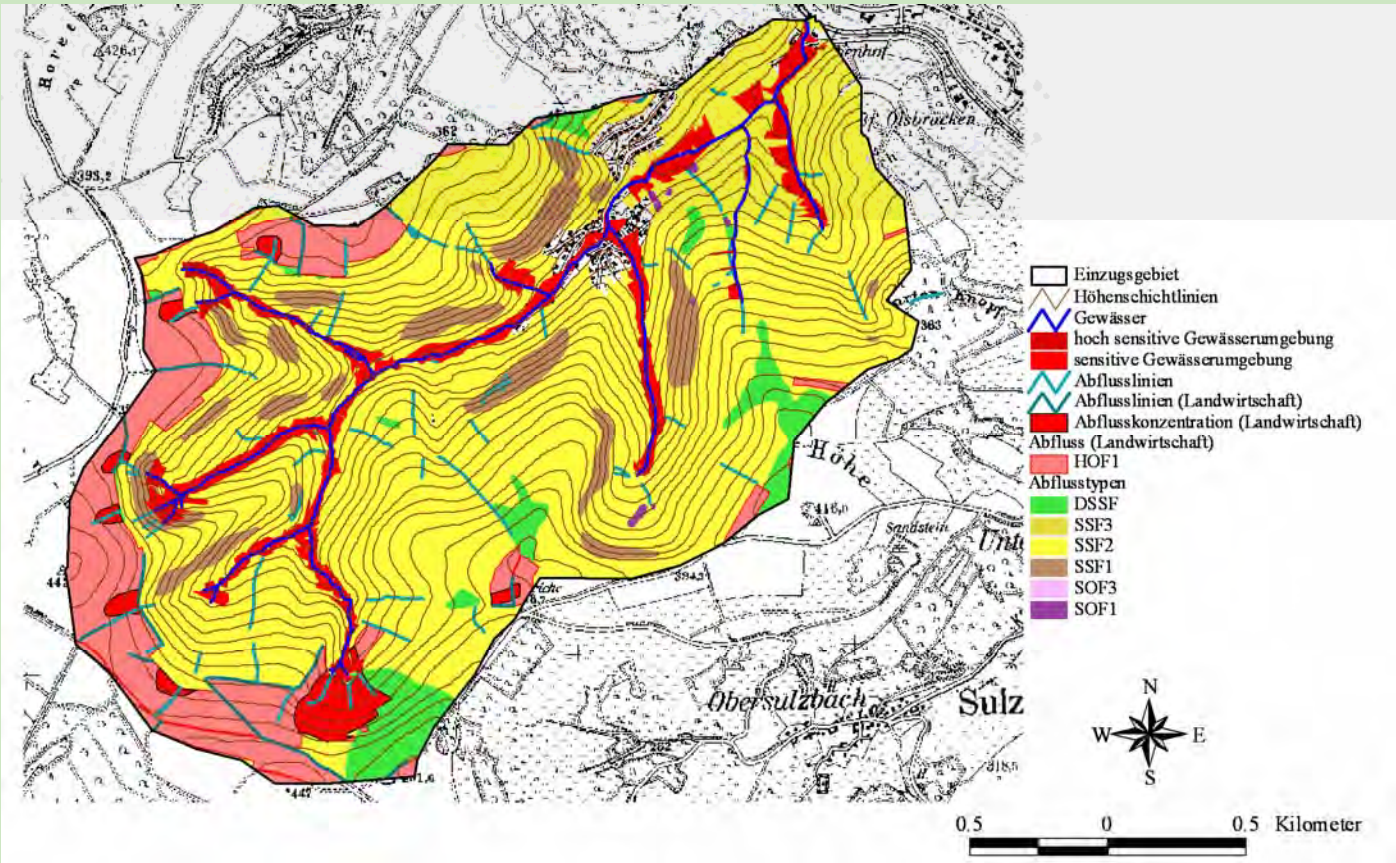




… can be derived from digital information about forest sites with a GIS-based expert system

Landesforsten Rheinland-Pfalz

Result of this assessment is a map about runoff sensitivity in headwater catchments

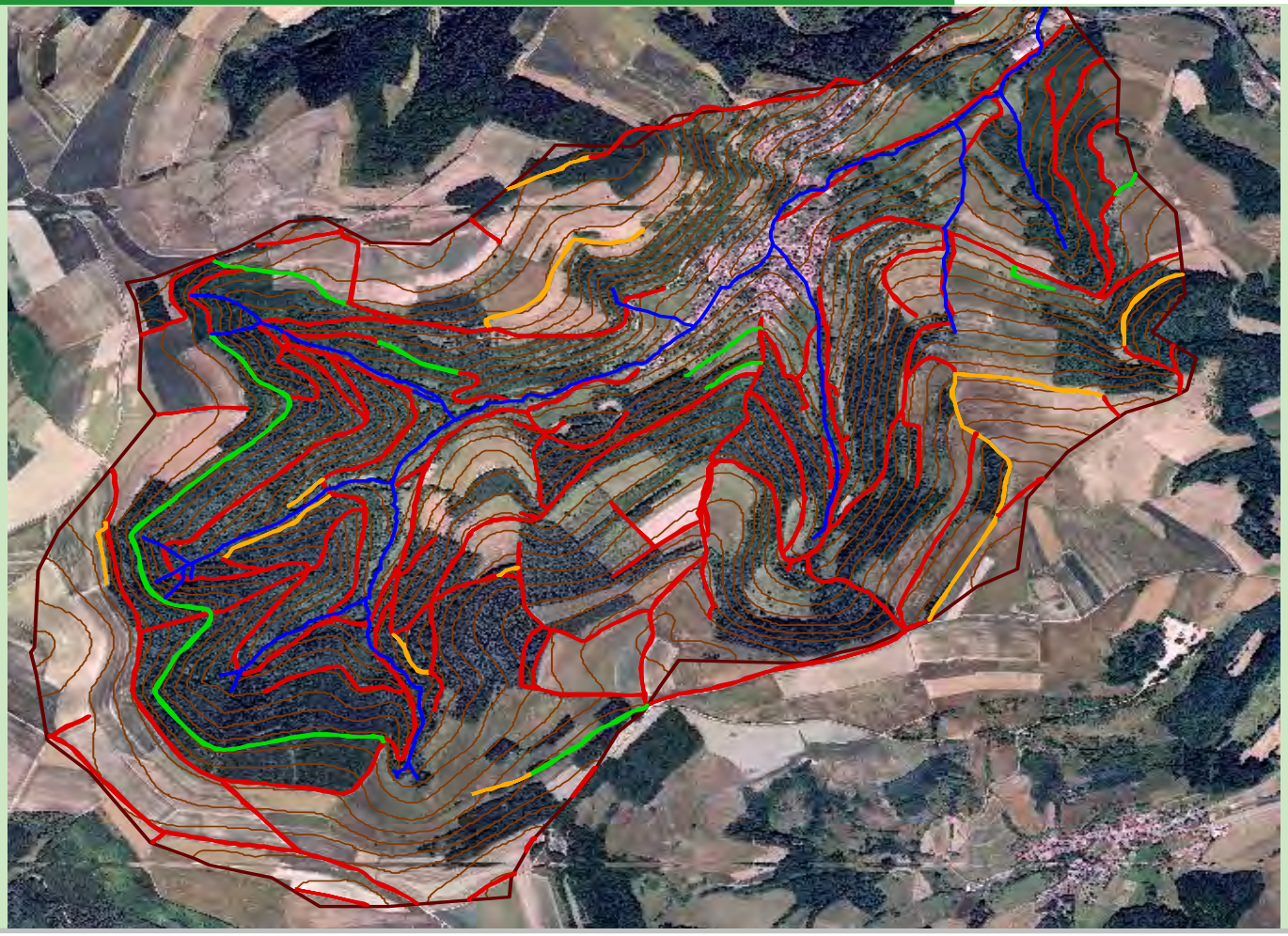


Besides hot spots linear structures (e.g. tracs of heavy machines, forest roads, drainage ditches) accelarate the discharge

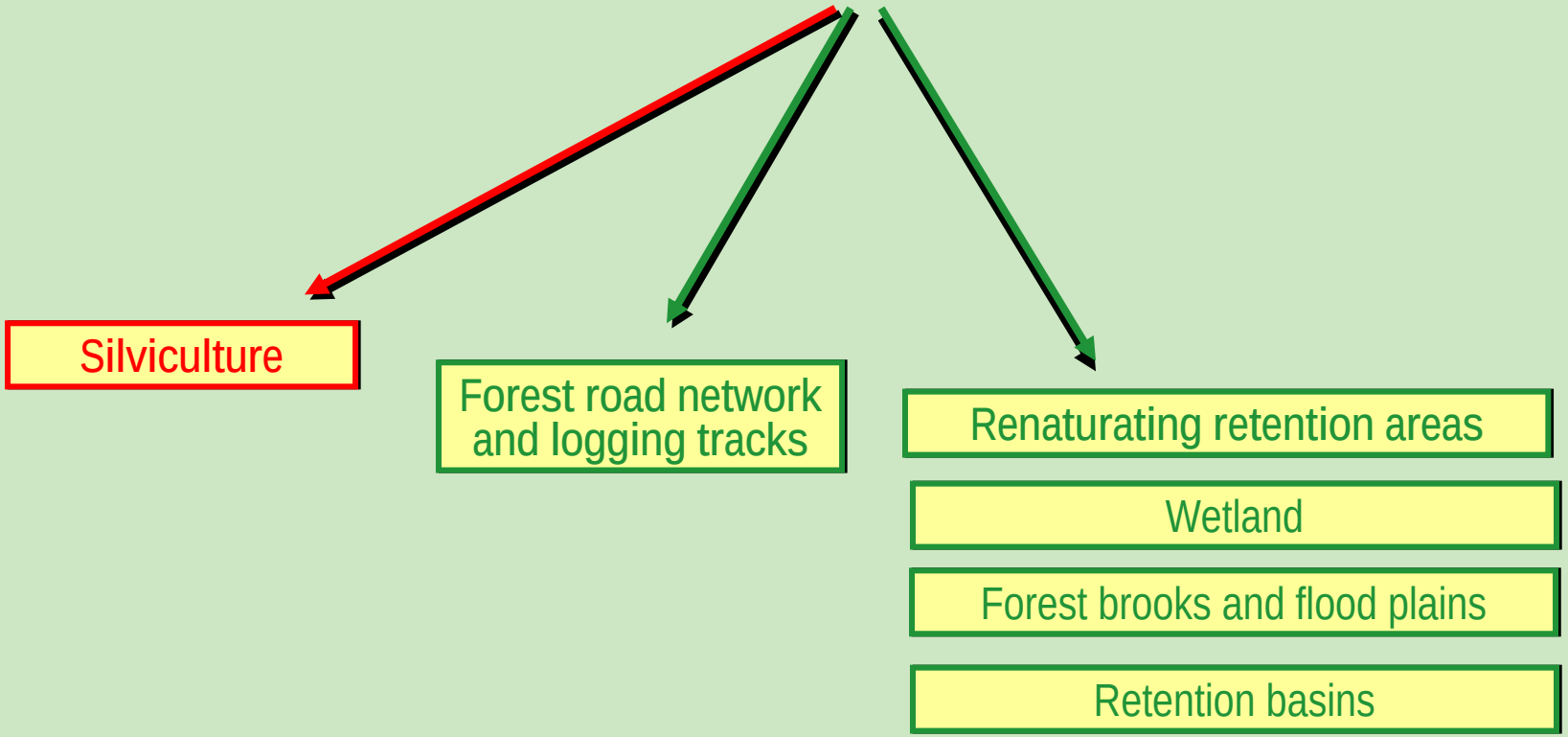
So, an inventory of discharge lines is also necessary

… and also an assessment of the runoff along forest roads !

Inventory map about runoff along forest roads

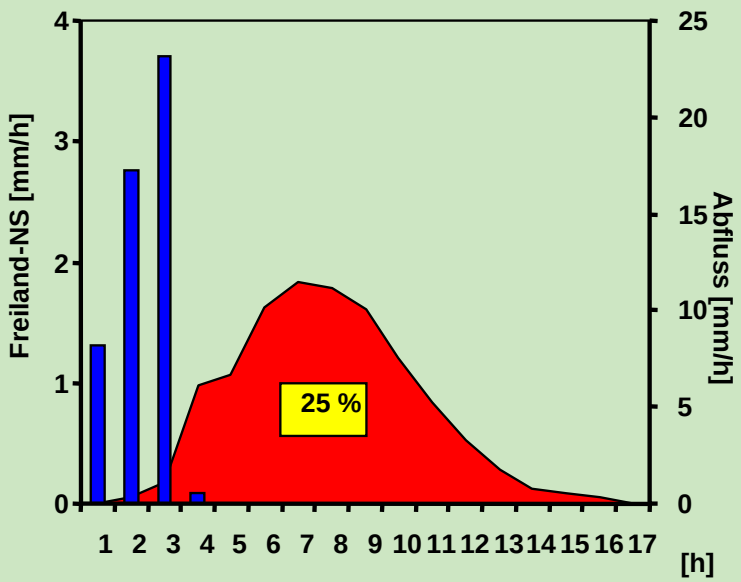


Runoff management in forests

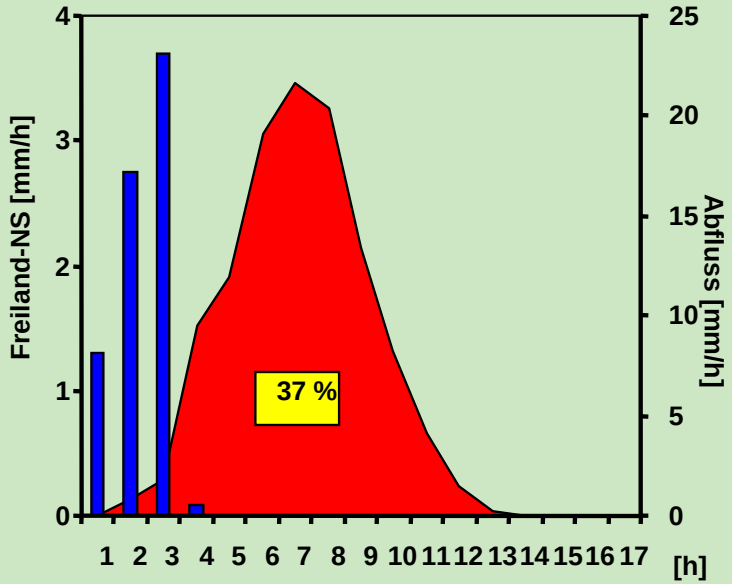


Forest and water retention / flash flood generation

(after heavy rain event



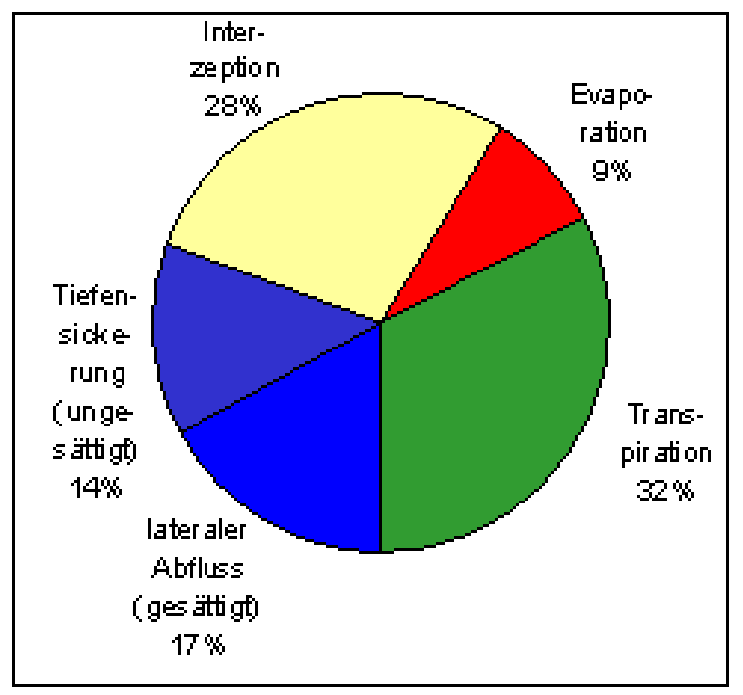
Deciduous forest



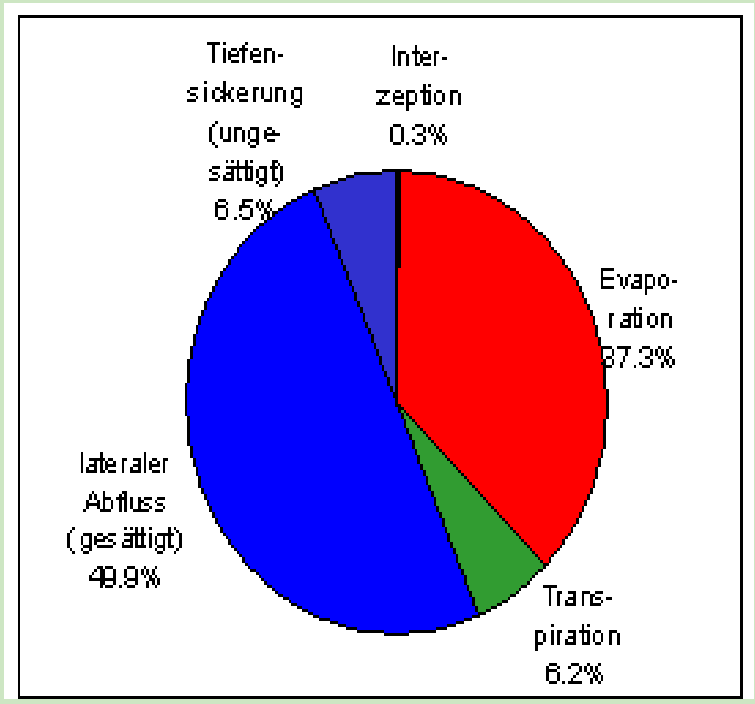
Clear cut

Bott & Schenk 2000)

Forest and water budget
(one year)



Forest



Clear cut

Supporting silvicultural measures

Early regeneration decades before harvesting

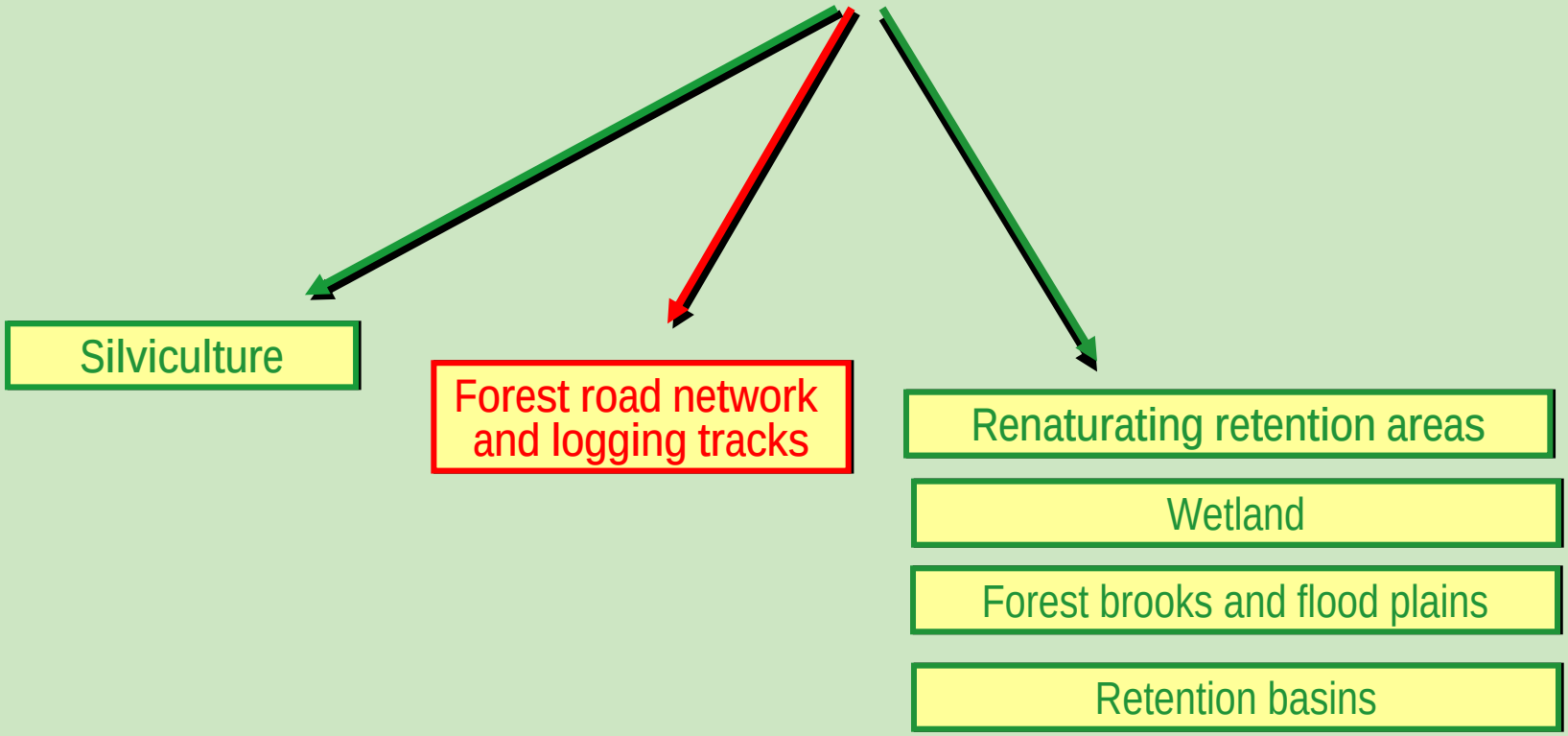
Supporting silvicultural measures

fast reafforestation after storm damages …. or clear cuts

Supporting silvicultural measures

Reafforestation of runoff hot spots

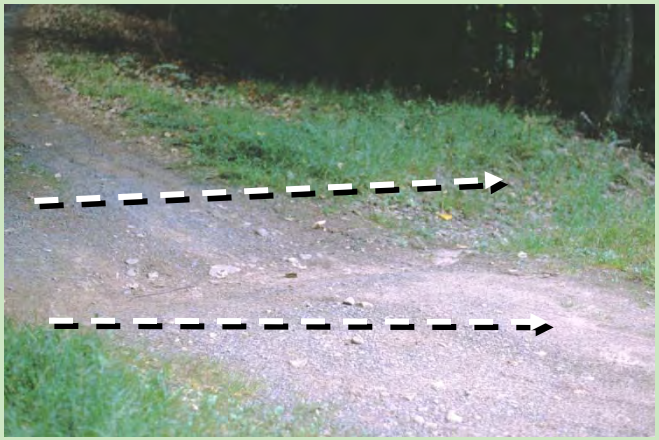
Runoff management in forests



Forest roads are only stable, if water saturation of the road substructure can be avoided.

Hence forest roads need a transverse profile to drain the water from the road surface not into ditches but into the adjacent forests.

On forest sites with a reduced infiltration capacity the road surface water should be collected in small decentralized artificial hollows with a capacity of about 50 m3 to 2000 m3, where it can evaporate or seep away.

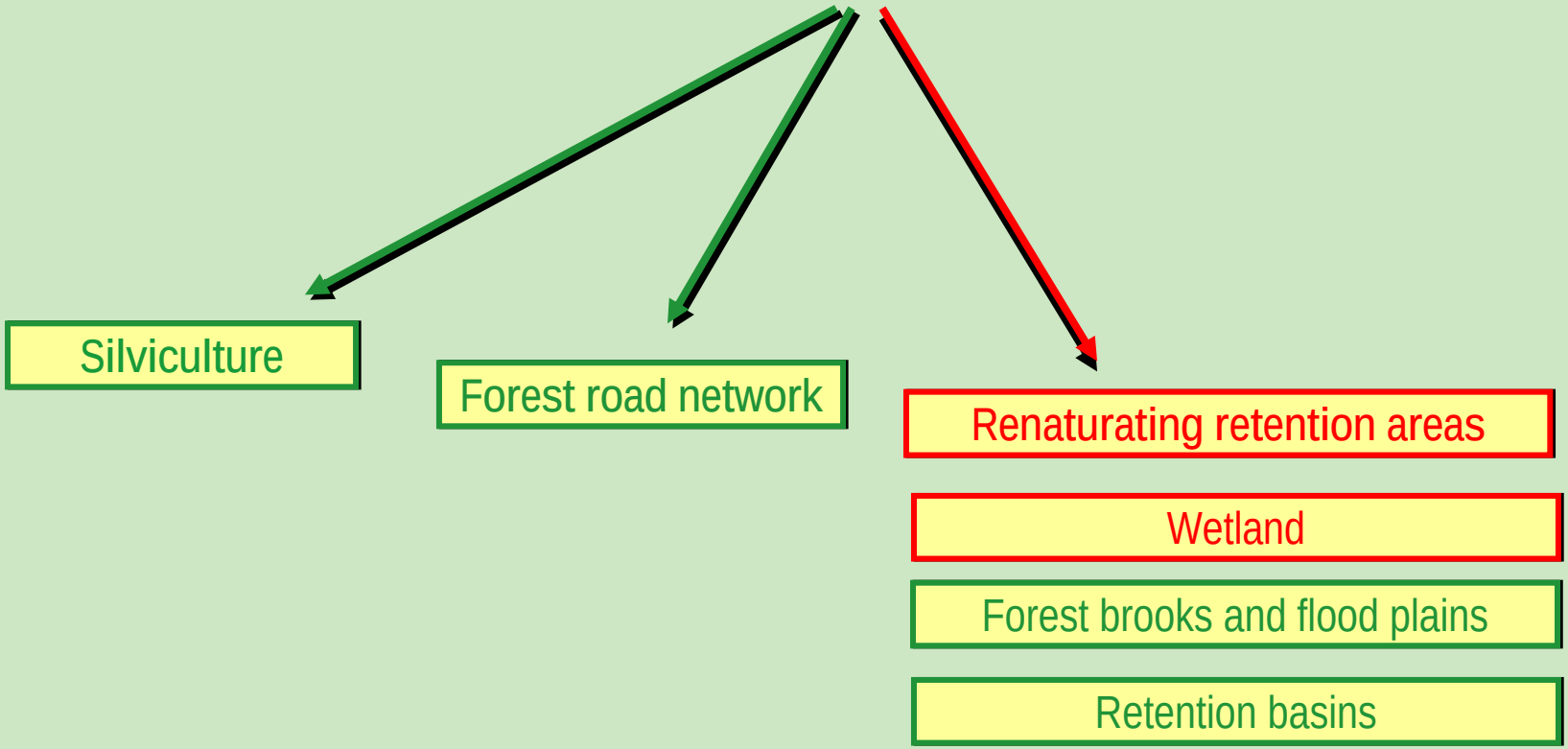


Driving with heavy machinery and soil compaction increase the danger of fast surface runoff and flashflood generation

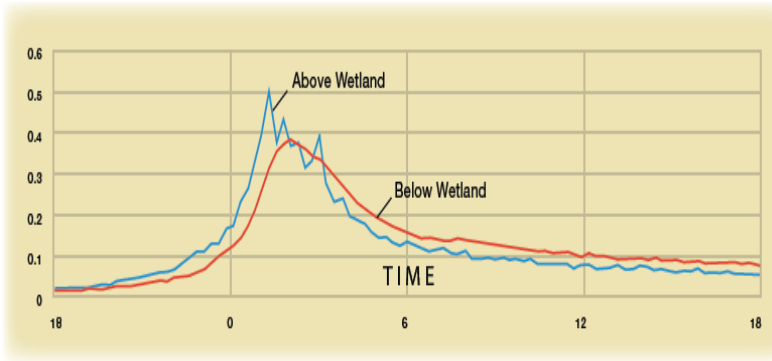
… Forest soils should not be compacted by heavy machineries. If harvester and forwarder have to work in the forests, they should only drive on a permanent network on logging trails or forest roads … and use the best technical solutions to prevent soil damages.

… alternative felling and logging systems can prevent soil compaction and linear surface runoff

Runoff management in forests



In wetlands with a big organic layer peak flows will be minimized



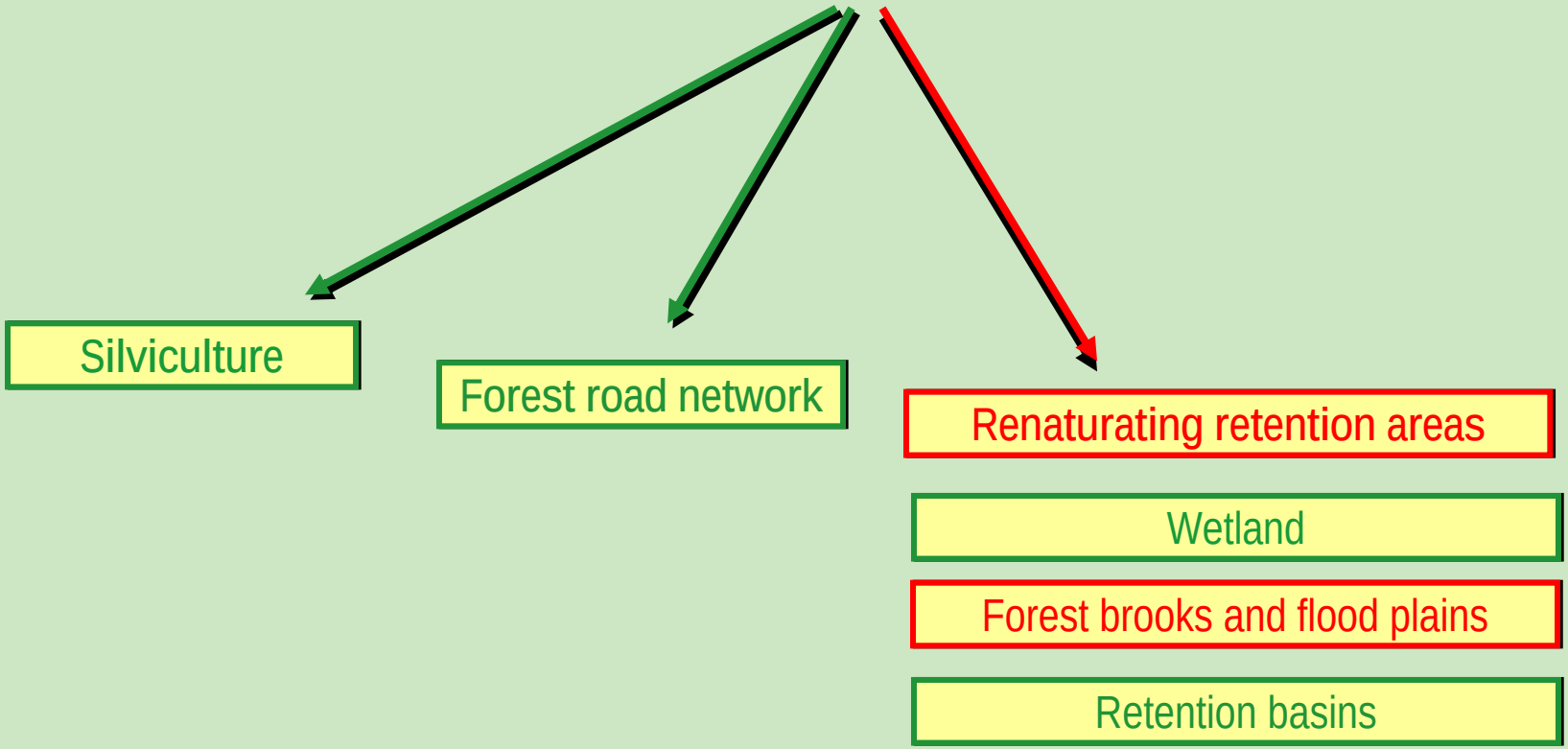
River flow data collected from the stations above and below the demonstration site. The blue line indicates the flow through an unrestored wetland. The red line shows how a restored wetland smooths the flow and holds onto water longer.

(„Flood planner, a manual for the natural management of riverfloods“; WWF Scotland 2006)

Disturbed wetlands should be renaturated.

Drainage ditches should be dammed.

Runoff management in forests

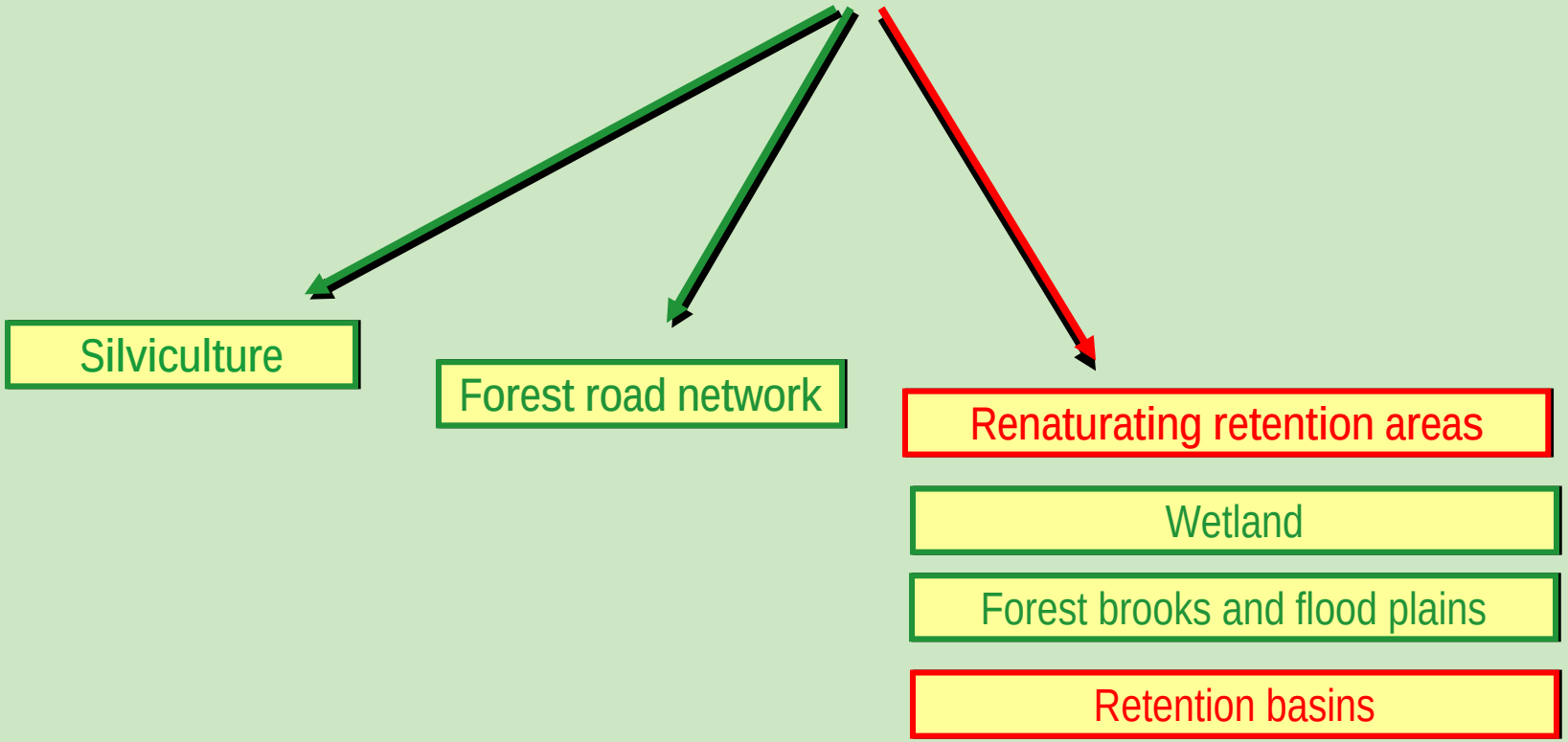


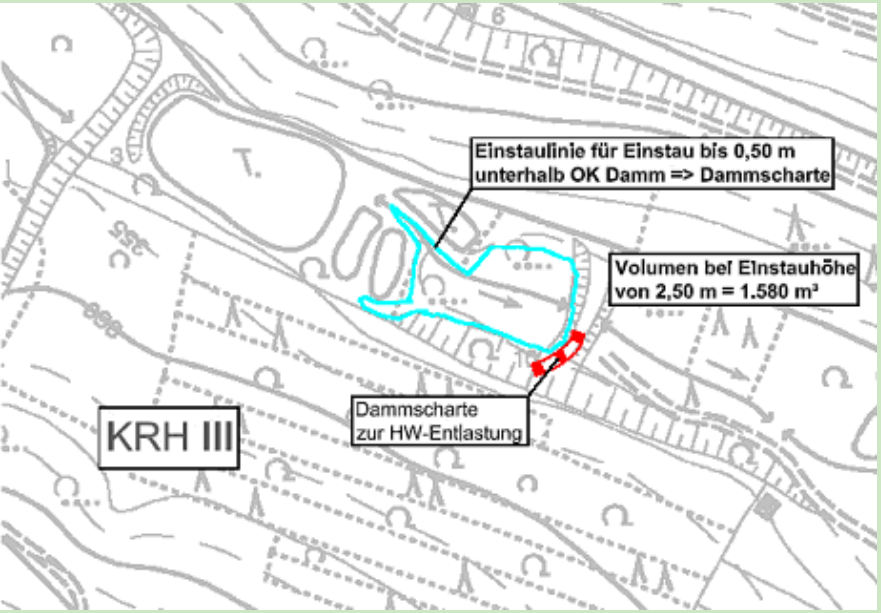
The natural structure of forest rivers should be protected or renaturated …

Renaturating of river structure includes their environment

The „natural“ development can be accelerated by „non-natural“ management …

Runoff management in forests





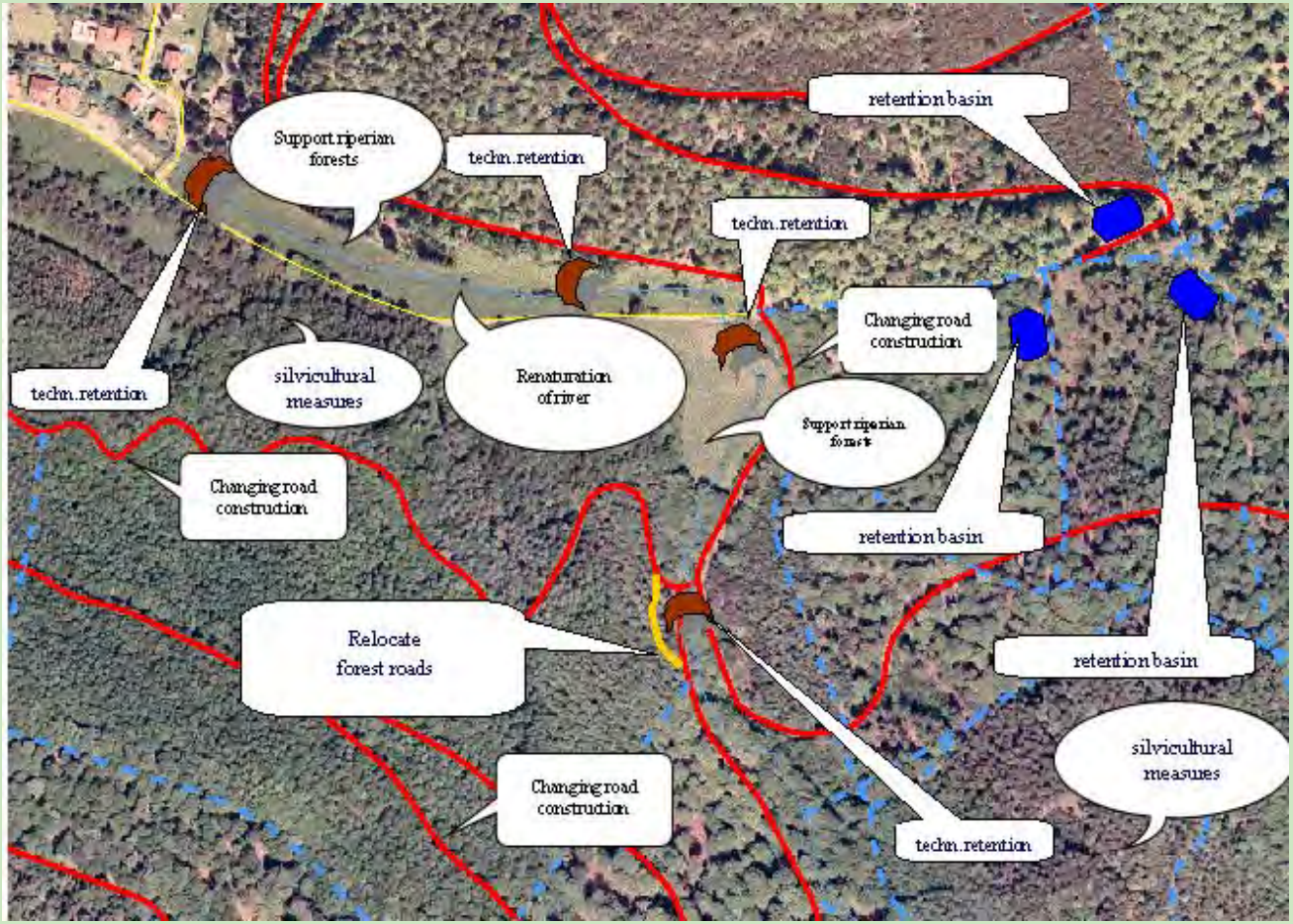
Retention basins are efficient measures for flood mitigation. They can be „naturally“ integrated behind crossing forest roads

Not longer used fishing ponds are also effective retention basins, …

but they should not be filled with water ….

How to close small retention basins …

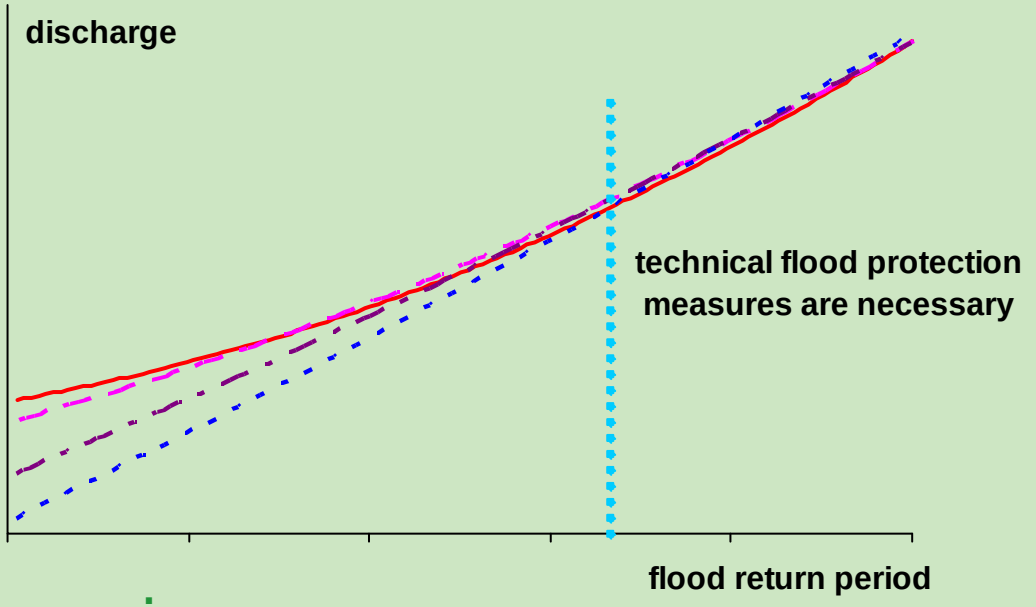
Decentralized retention measures have only a chance to be efficient in headwater catchments, if all possibilities in these catchment areas are achieved, always beginning close to the spots of run-off generation



Efficiency of precautionary forestry water retention measures

In the microscale each additional flood precautionary measure makes the discharge curves diverge from their starting points and meet on the flood frequency curve at a higher flood return period.

Above the point of intersection, when the reduced discharge curves meet the “normal” flood frequency curve, technical flood-protection measures are necessary, …



… particularly if large scale climatic situations are responsible for the generation of floods.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