



Numerical simulation of flood protection measures in the catchment area of the river Vicht

Felix Steudtner, M.Sc. RWTH

Institute of Hydraulic Engineering and Water Resources Management

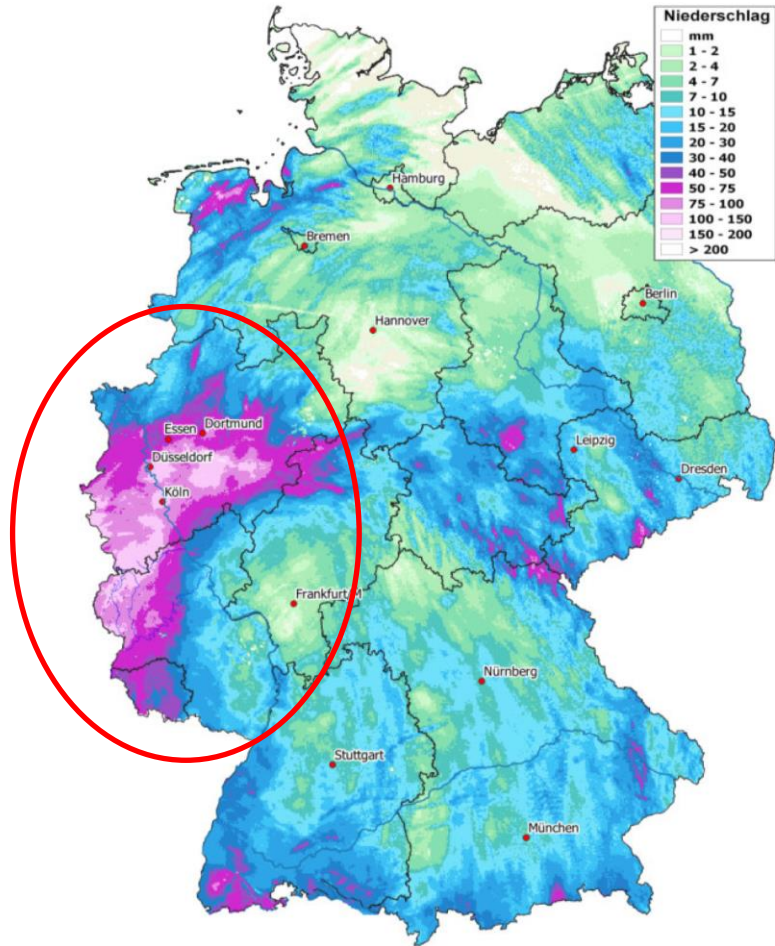
RWTH Aachen University

12.09.2023

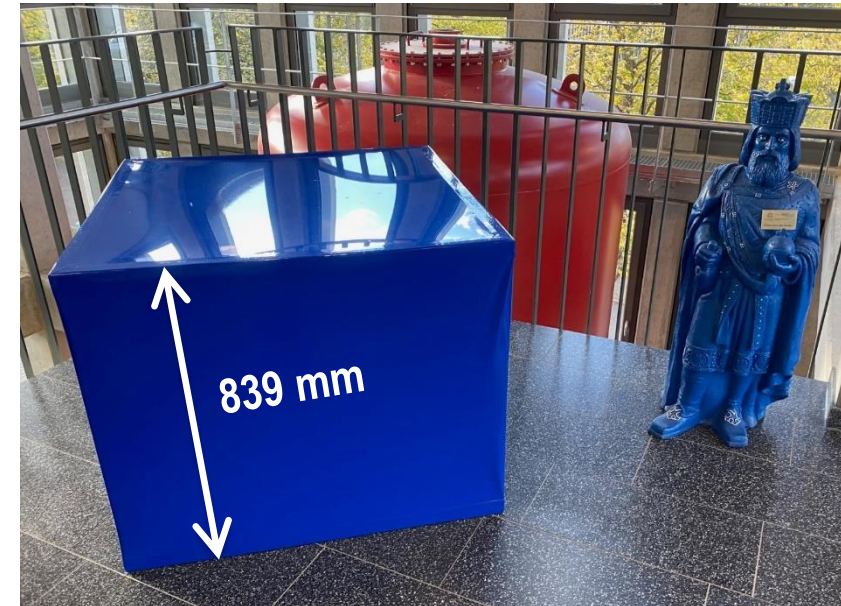


Introduction and motivation

- THE FLOOD EVENT IN JULY 2021-



(Schäfer et al. 2021)



(IWW 2023)



- **144.3 mm** within **72 h**
- average July 1981 - 2010: 74 mm

(DWD 2021)

Introduction and motivation

- DAMAGE IN STOLBERG AND VICHT -



(FloodTag 2022)



(FloodTag 2022)



(IWW 2021)

“After the flood is before the flood.”

- development of the master plan "**Flood resilient urban and regional development for the catchment area of the river Inde and Vicht**“
- numerous institutions, municipalities and external experts involved
- from water management and hydraulic engineering to urban and regional planning and disaster management

Aim:











To identify the most promising actions to improve resilience to the impacts of extreme flooding in the region and to take into account the future challenges resulting from climate change.

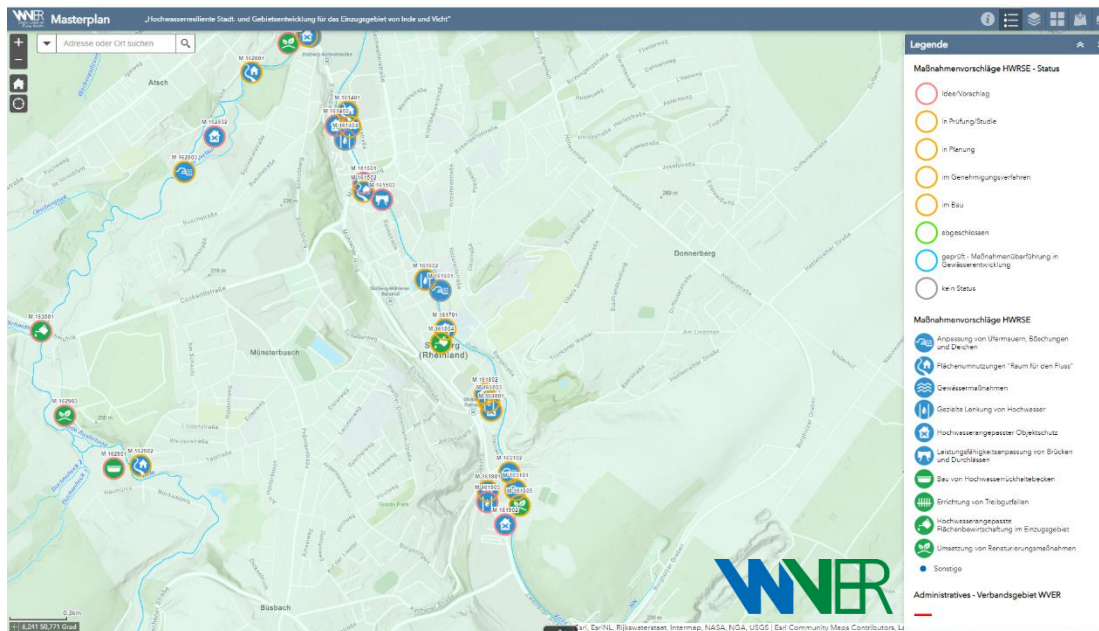


Introduction and motivation

- MASTERPLAN ESCHWEILER/STOLBERG -

➤ 93 possible flood protection measures on the river Vicht identified

- 17  construction of flood retention basins
- 9  targeted steering of floods
- 7  construction of flotsam traps
- 5  performance adjustment of bridges and culverts
- 6  adjustment of bank walls, embankments and dikes
- 9  land reutilization for "space for the river"
- 11  implementation of renaturation measures
- 4  flood-adapted land management in the catchment area
- 13  flood-adapted object protection
- 12  river measures



Introduction and motivation











- MASTERPLAN ESCHWEILER/STOLBERG -

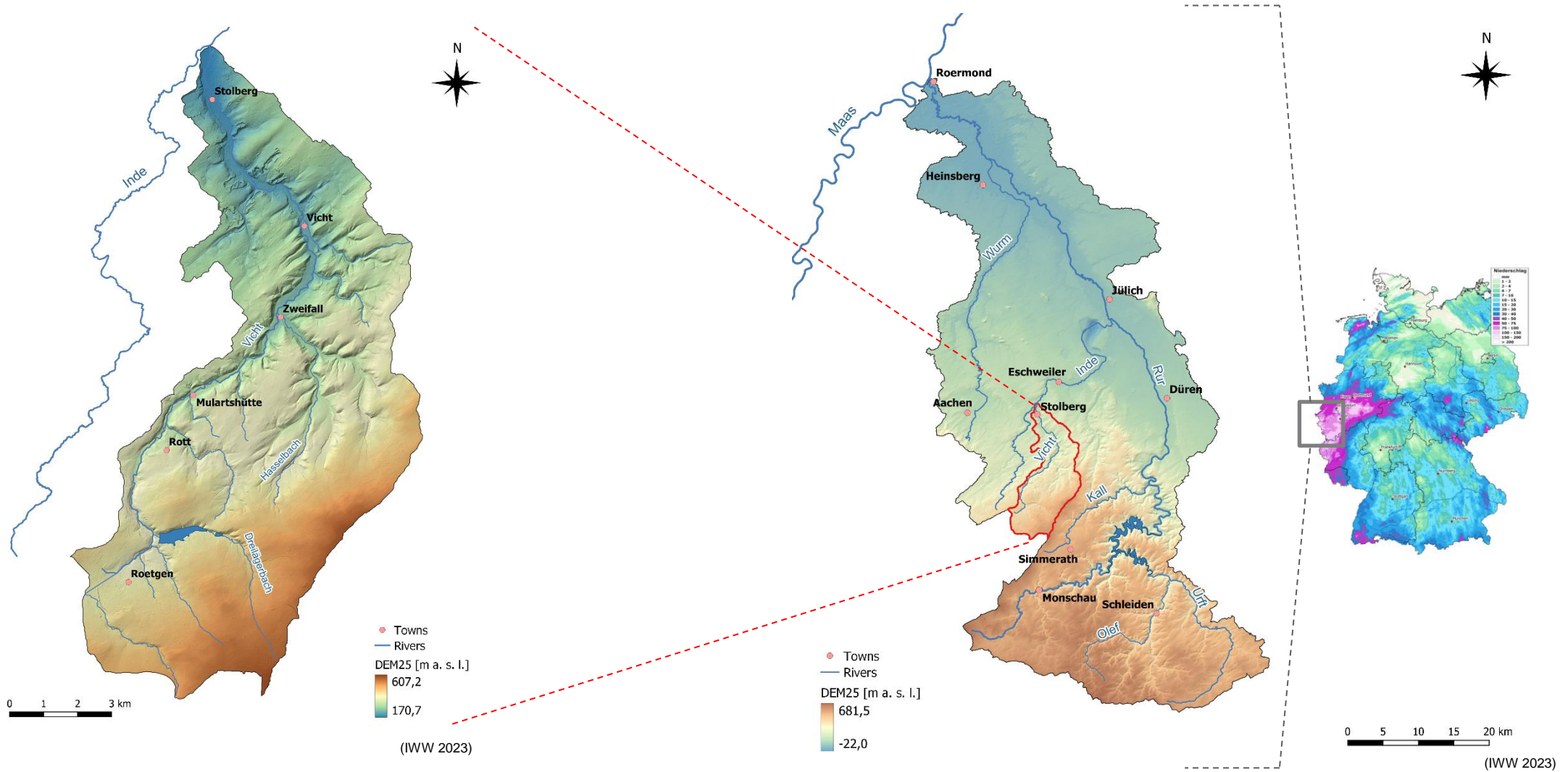


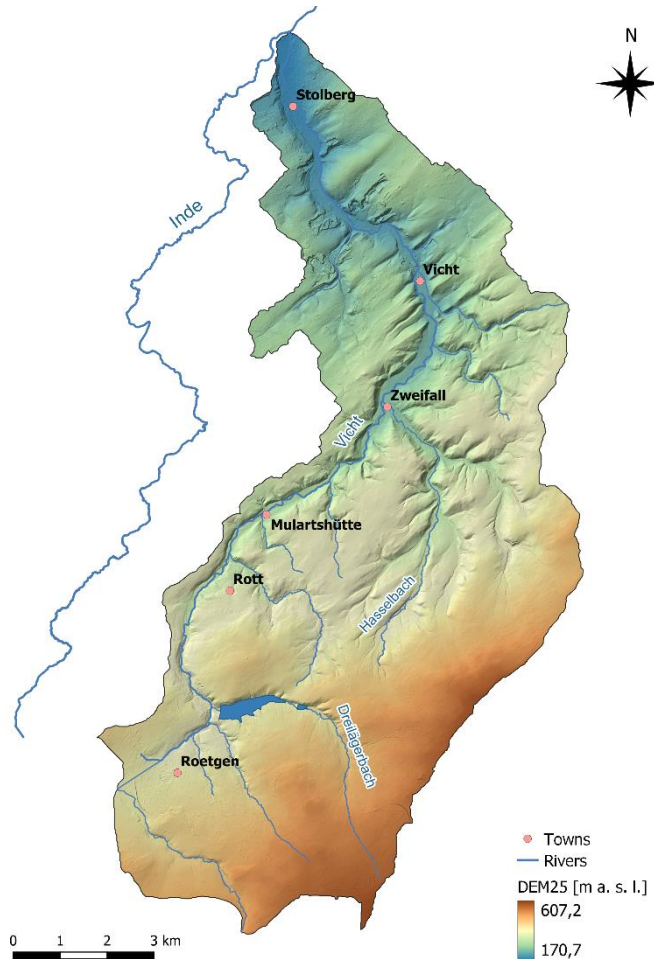
➤ 93 possible flood protection measures on the river Vicht identified

Research questions:

- 1) Which flood protection measures have a measurable effect on reducing the flood wave or on delaying the flood wave?
- 2) What improvement in flood protection is possible through individual or all planned flood protection measures? What residual risk remains?
- 3) Can land use be used to identify factors that contributed to the high level of damage?
- 4) How does flood risk change in affected regions due to different climate scenarios?

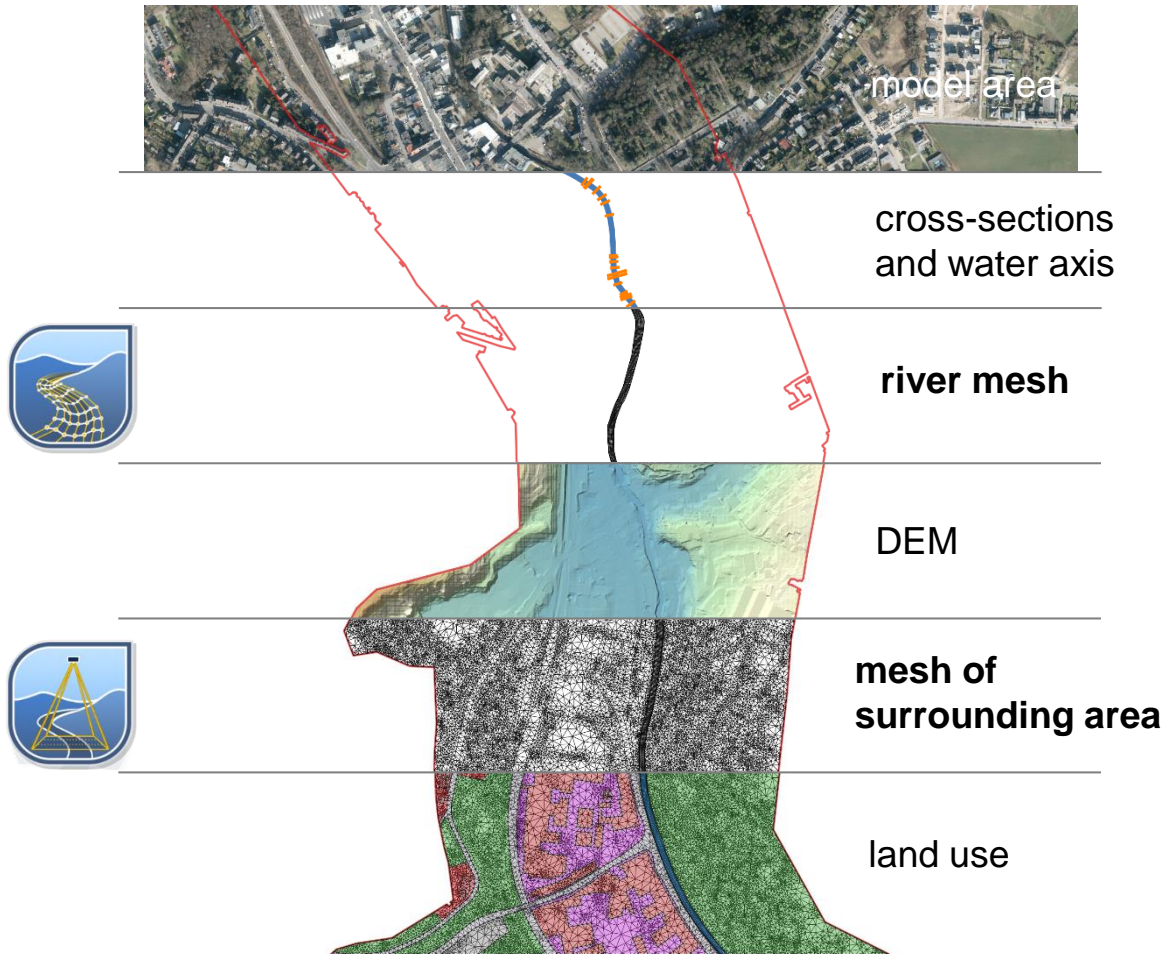
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|----|---|---|
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(IWW 2023)

- **catchment area:** 102,84 km²
- **status:** 4th-order stream (Inde → Rur → Meuse → North Sea)
- **spring:** Roetgen (Grölisbach)
- **mouth:** Stolberg
- **spring height:** 413 m a. s. l.
- **mouth height:** 166 m a. s. l.
- **elevation difference:** 247 m
- **length:** 23 km
- **slope:** 10,74 ‰



Use of HydroAs

Hydrotec

- **HydroAs River Mesh**

- ✓ generating the river mesh from cross-section data



- **HydroAs Mesh**

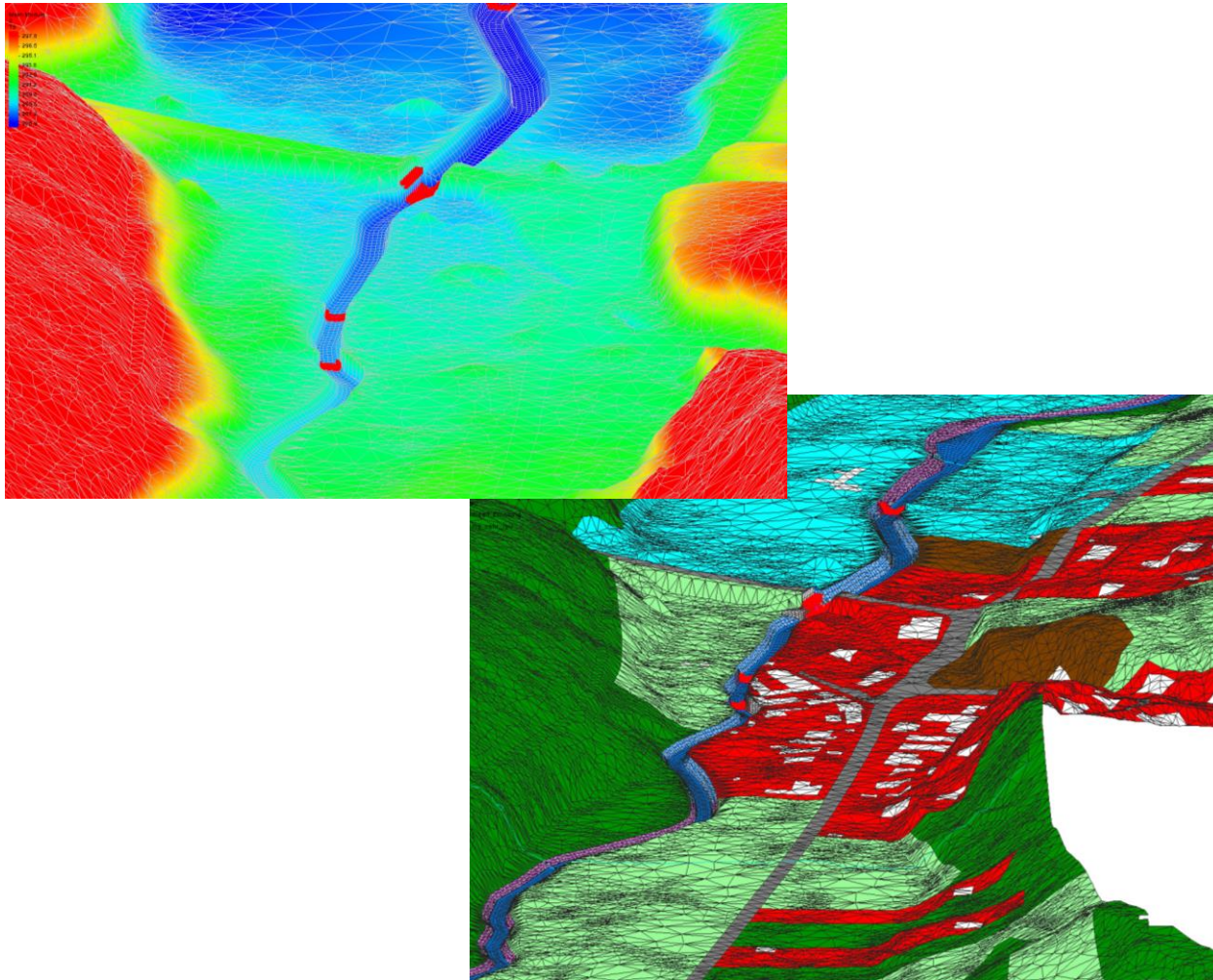
- ✓ generating a mesh of the surrounding area



- **HydroAs**

- ✓ 2D simulations of streams

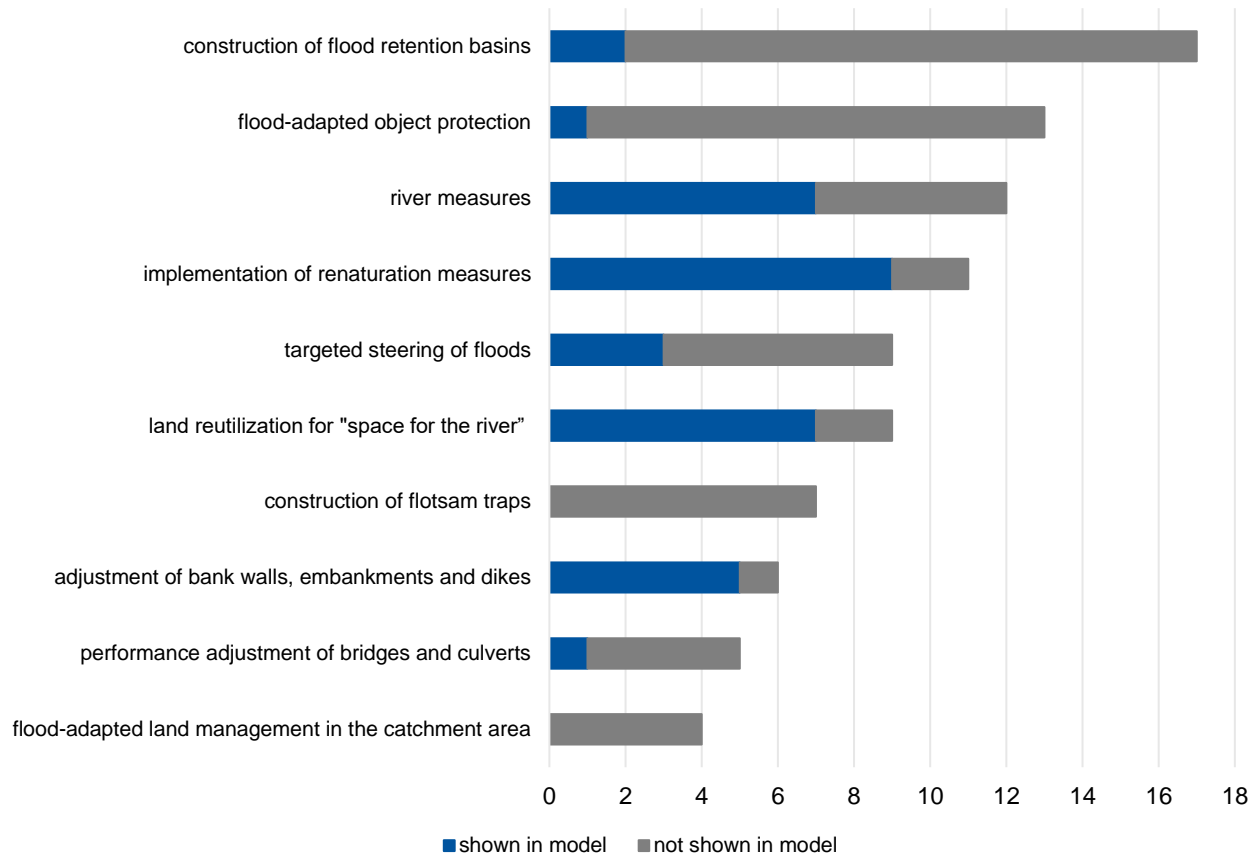




Outcome of different meshes for different research questions:

- Actual state Vicht August 2023
- Actual state HRB 2027
- Actual state steering measures
- **Actual state natural measures**
- Actual state potential analysis total
- **Stolberg Europatunnel Bastinsweiher**
- **Stolberg Europatunnel railroad embankment**

flood protection measures implemented in the model

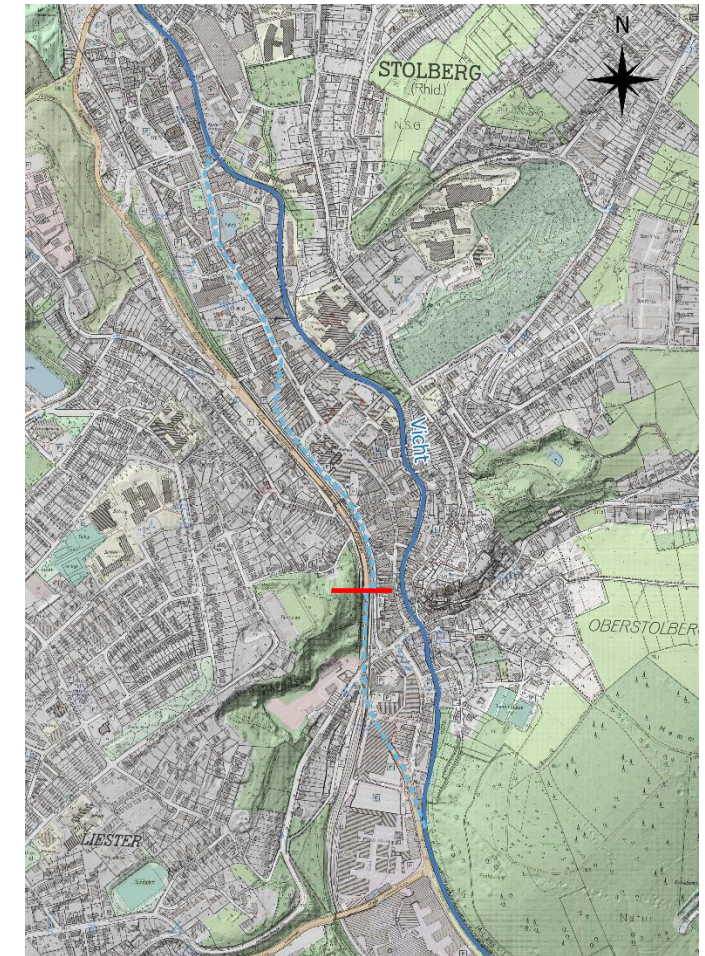
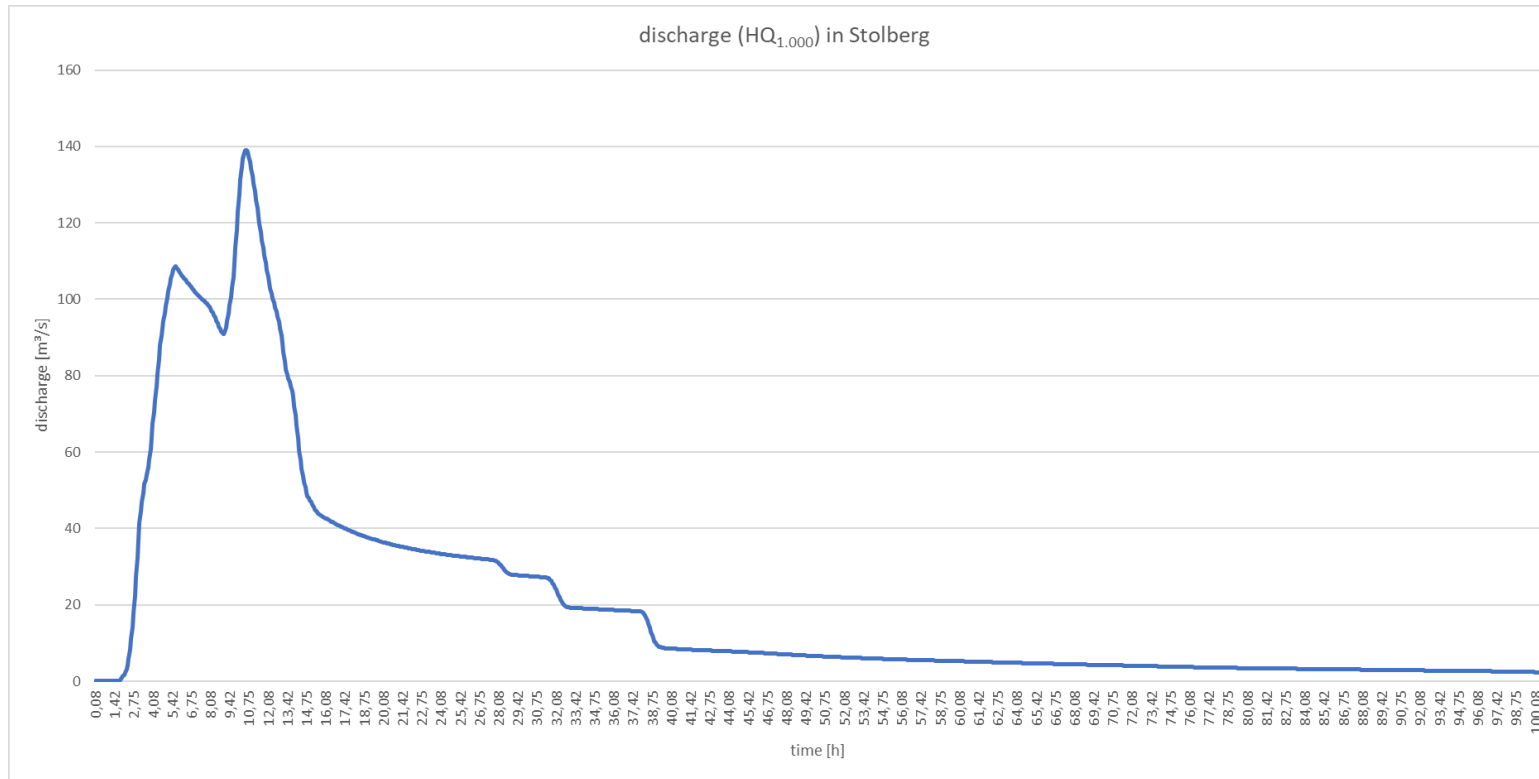


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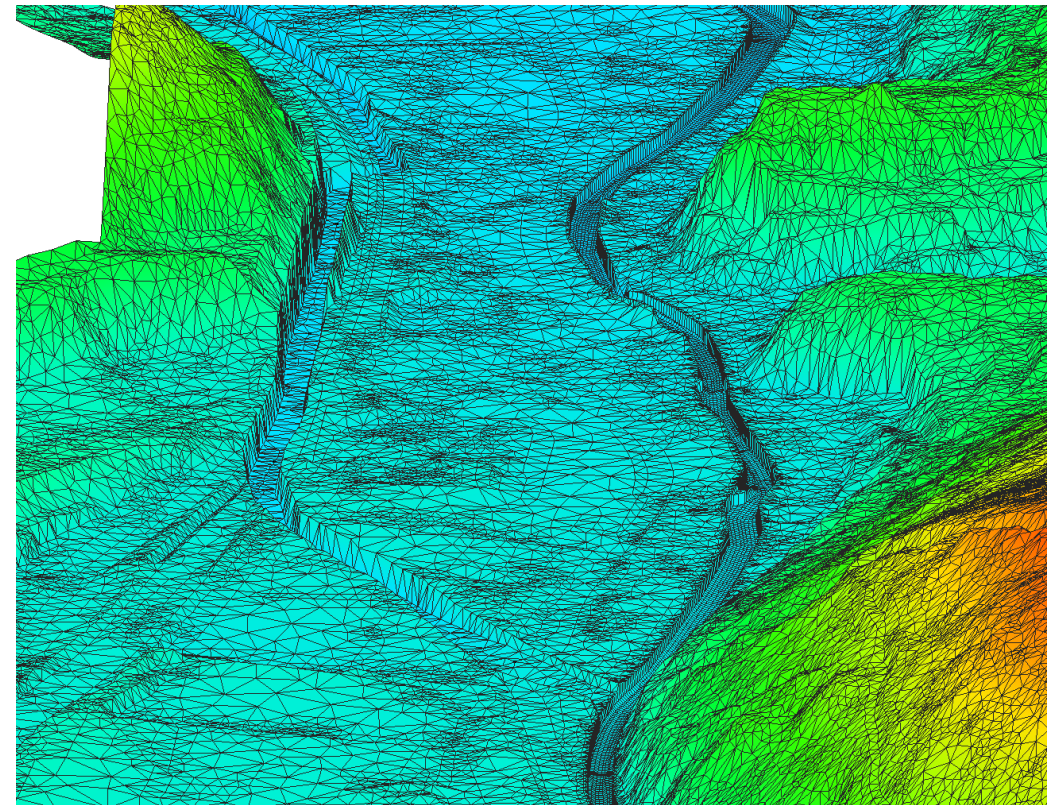
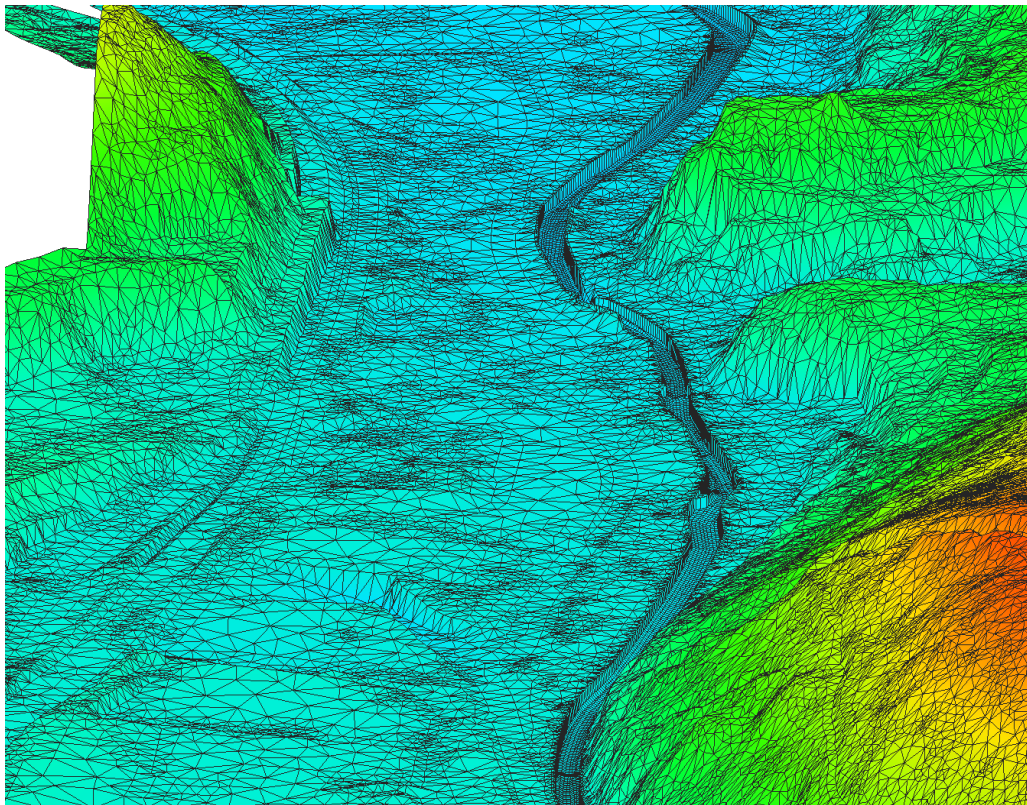


Targeted steering of flood waters via the Europatunnel in Stolberg - Option 1 „Bastinsweiher“





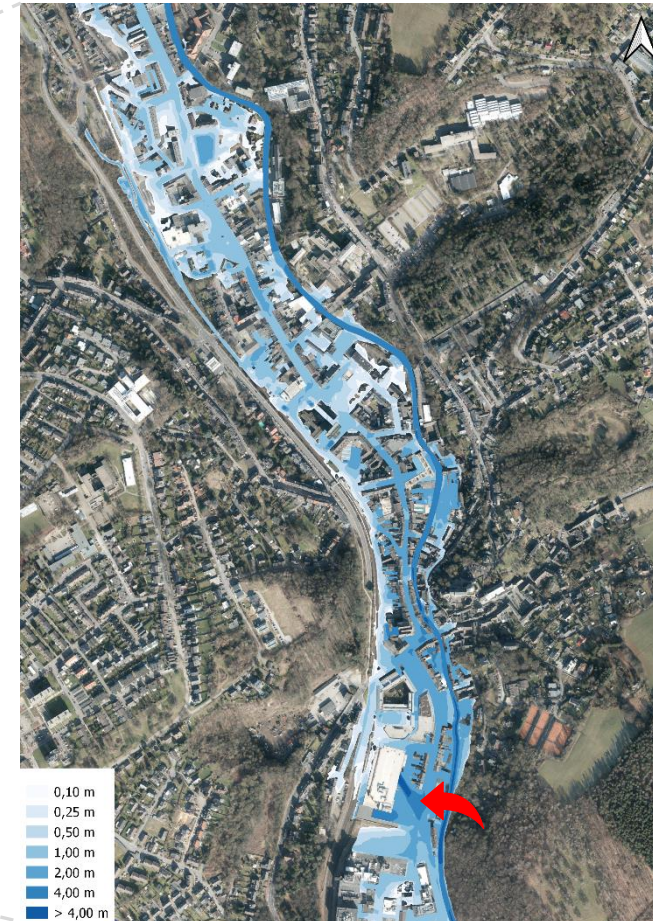
Targeted steering of flood waters via the Europatunnel in Stolberg - Option 1 „Bastinsweiher“



Results

- STOLBERG EUROPATUNNEL -

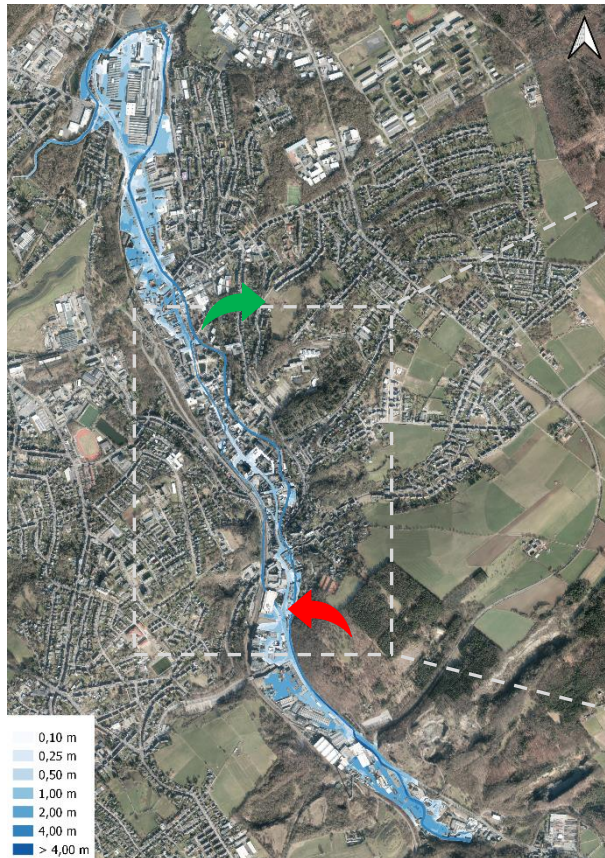
Simulation without measure:



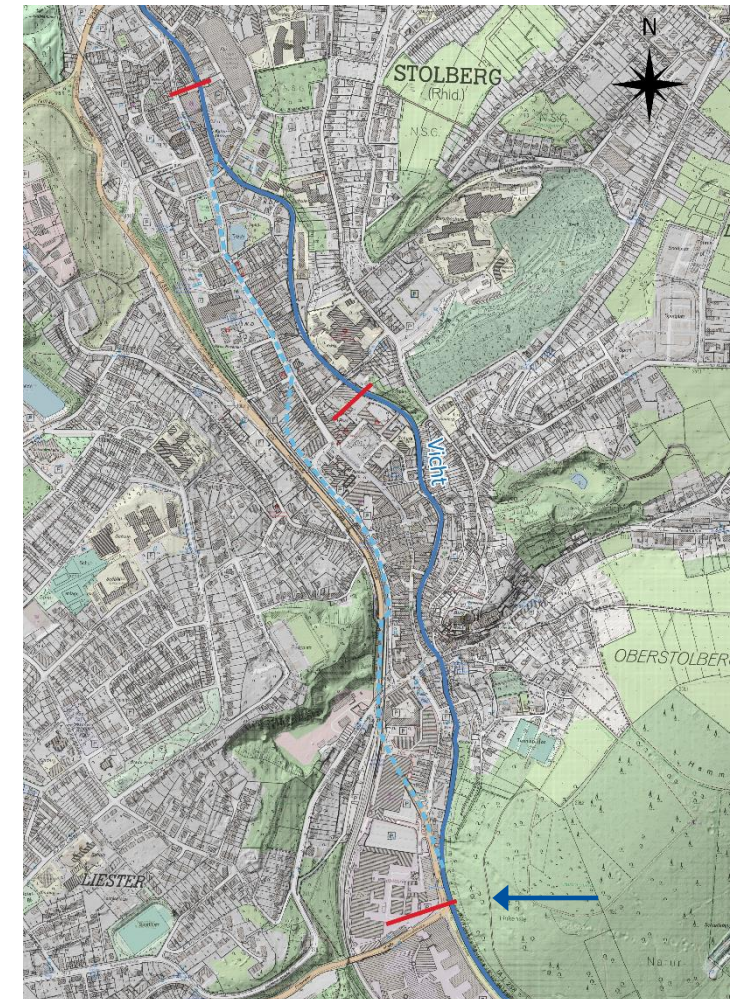
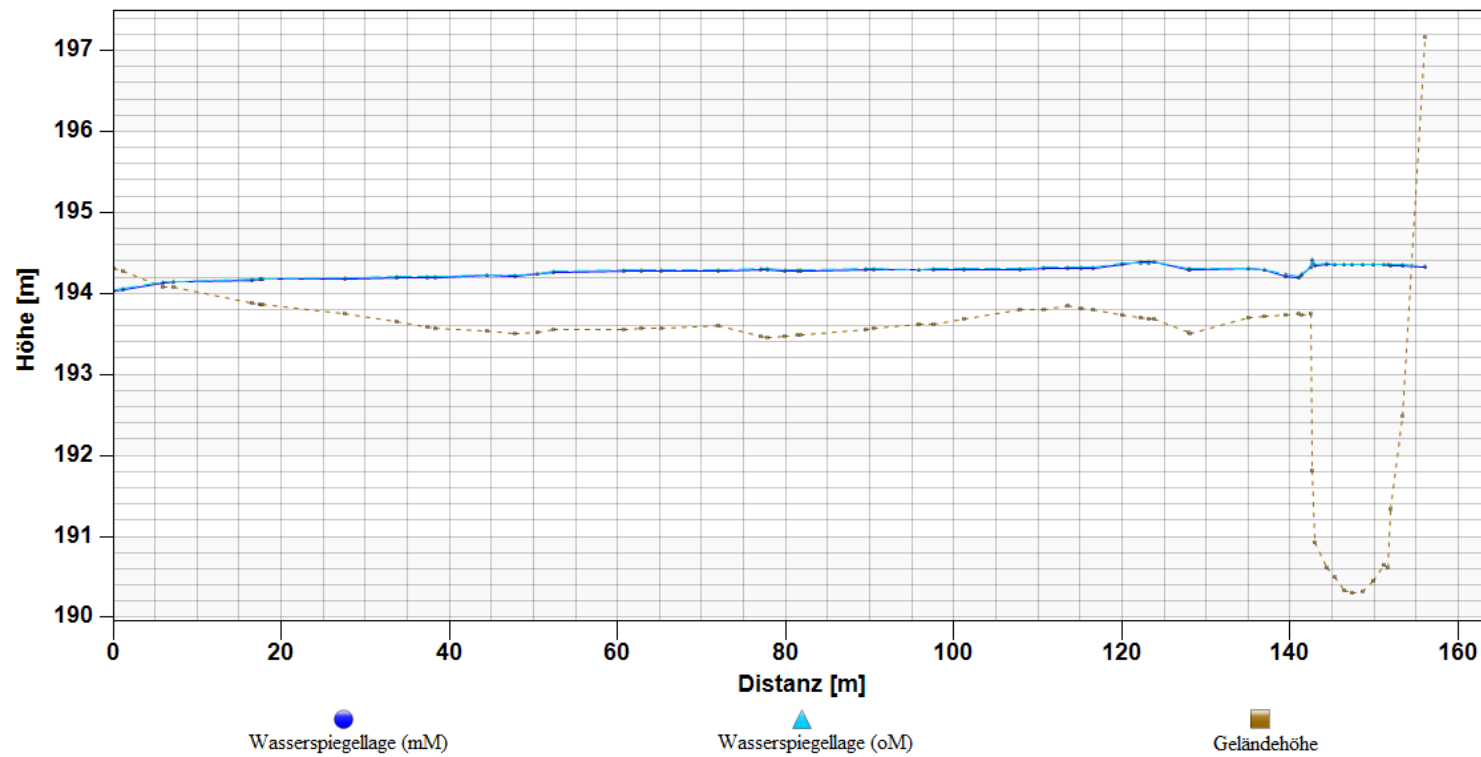
Results

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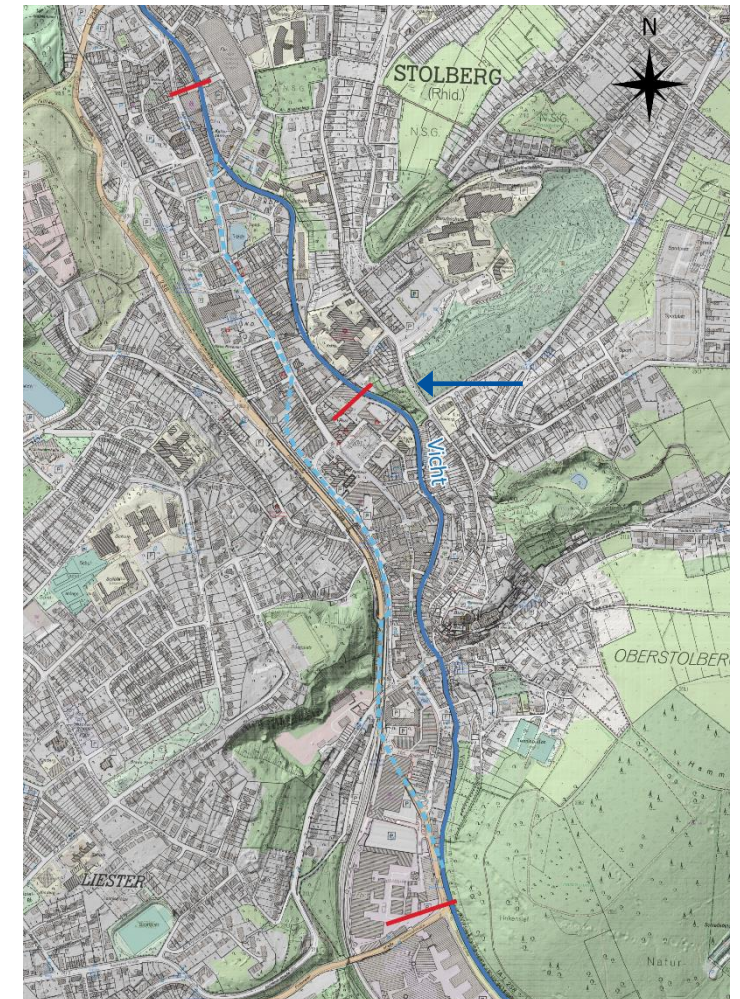
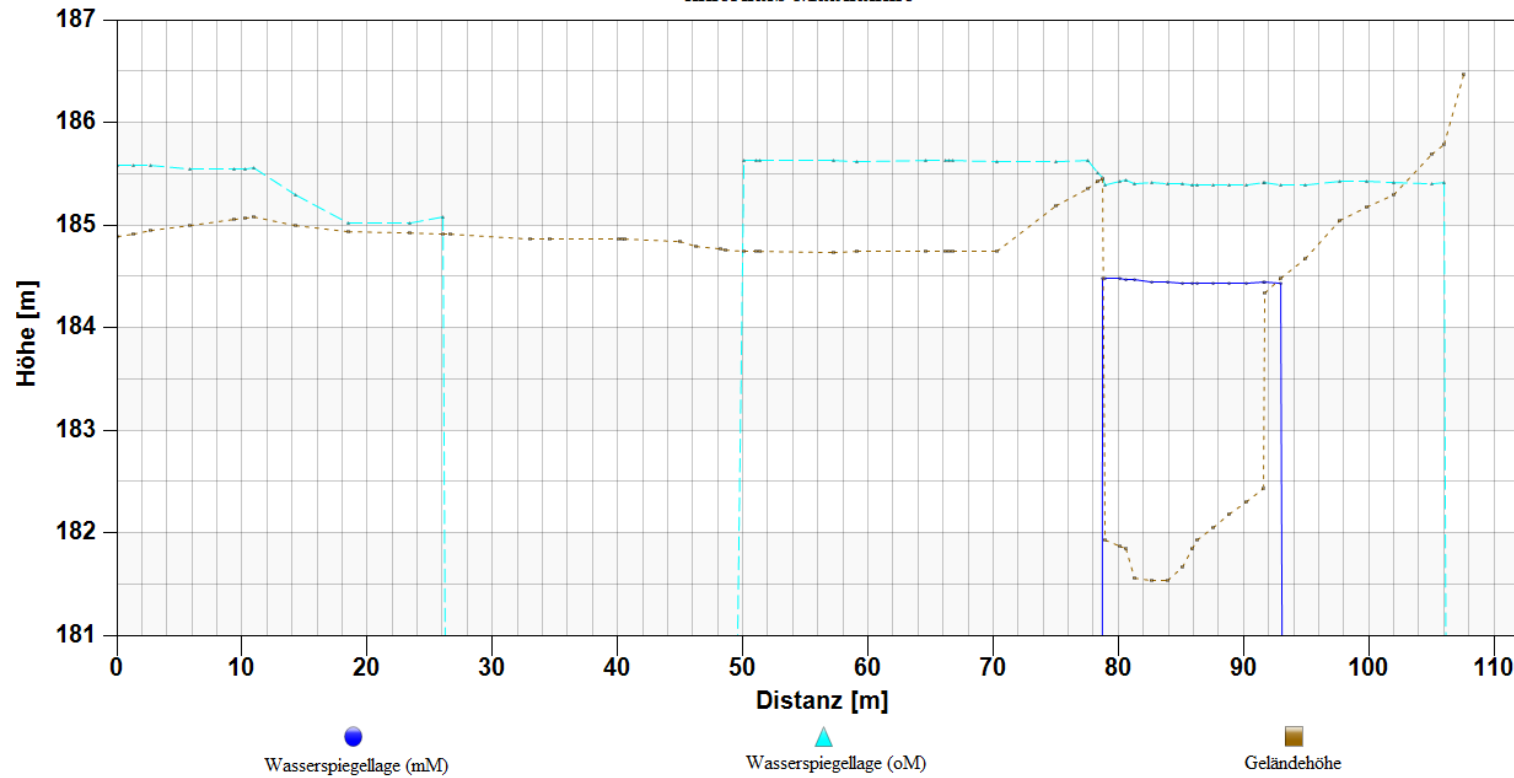
Simulation with measure:



Vergleich - Wasserspiegellage vor Maßnahme



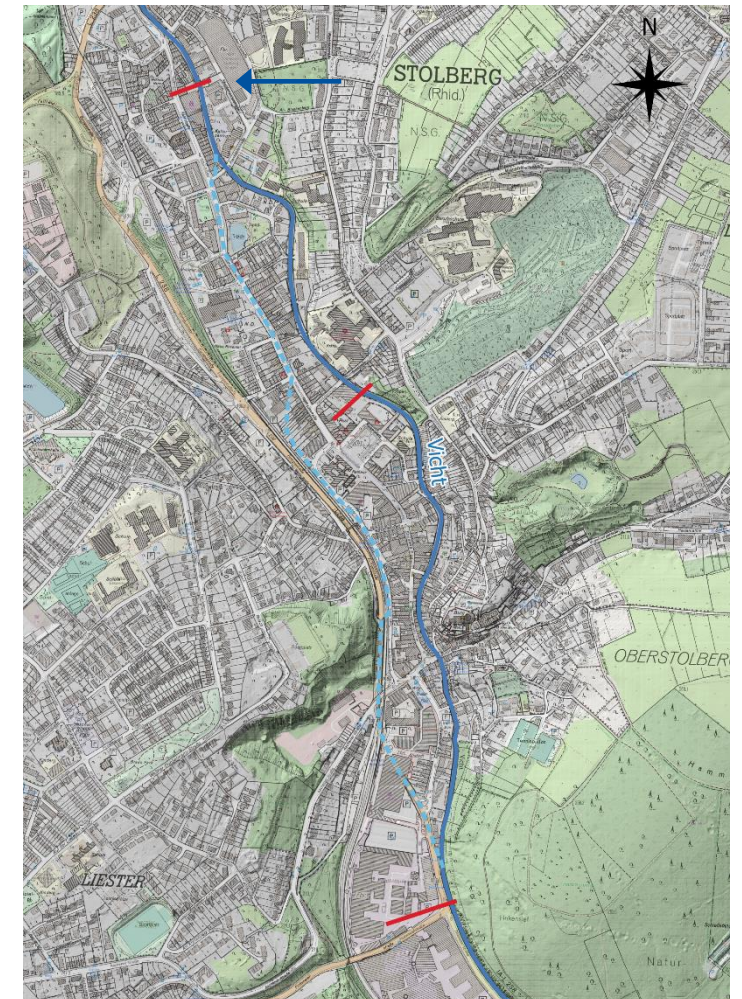
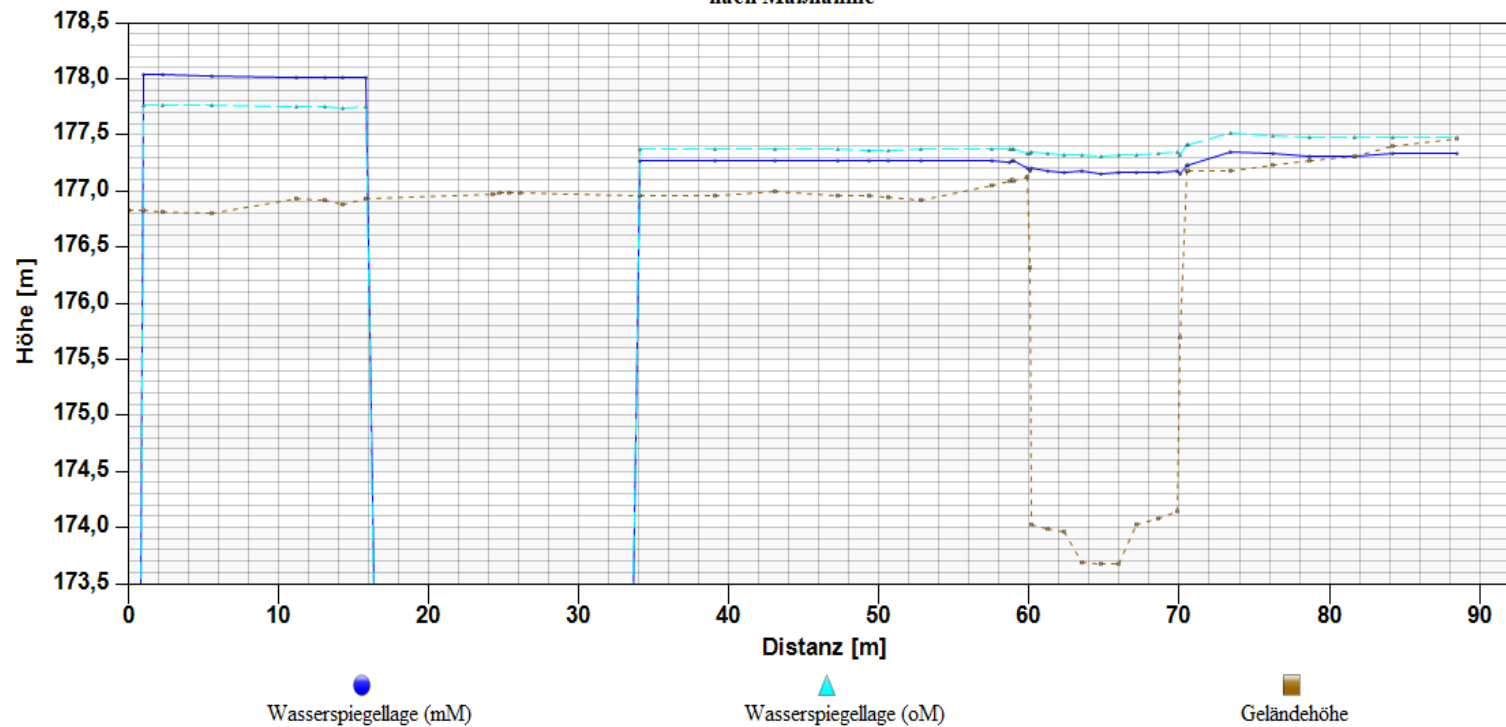
Vergleich - Wasserspiegellage innerhalb Maßnahme



Results

- STOLBERG EUROPATUNNEL -

Vergleich - Wasserspiegellage nach Maßnahme

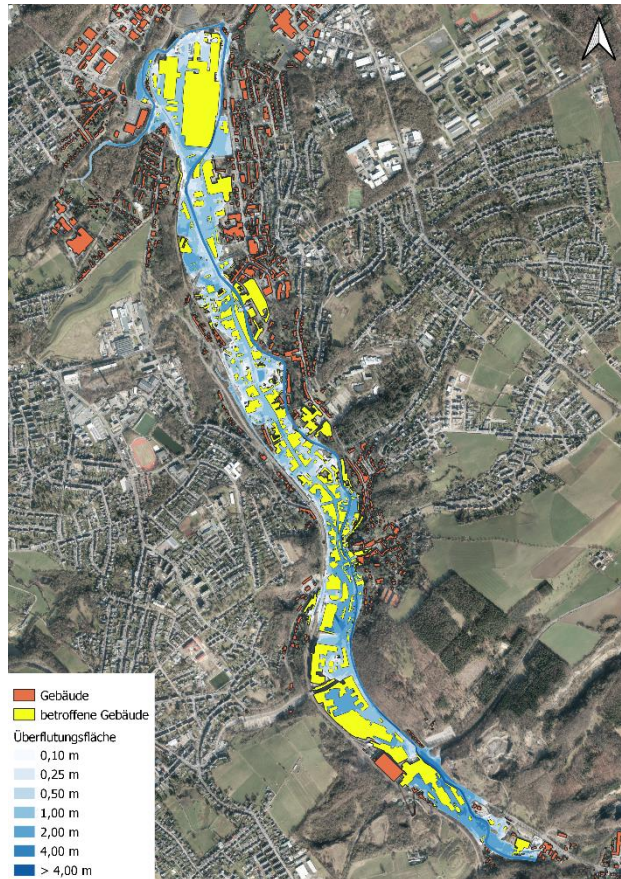


difference of the measures:

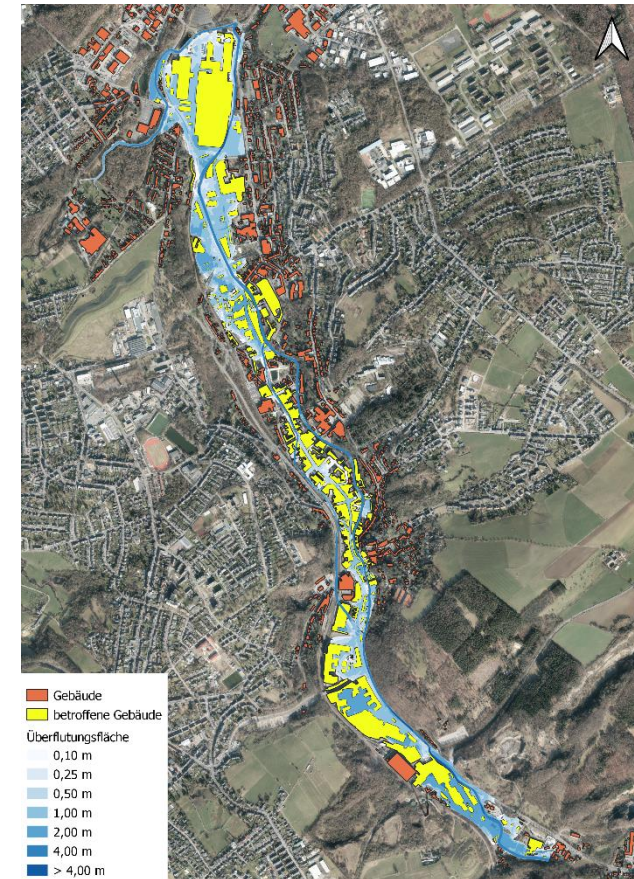
- floodplain without measure: 572,072 m² (0.572 km²)
 - floodplain with measure: 469,821 m² (0.470 km²)
- » Differenz von 102,251 m²



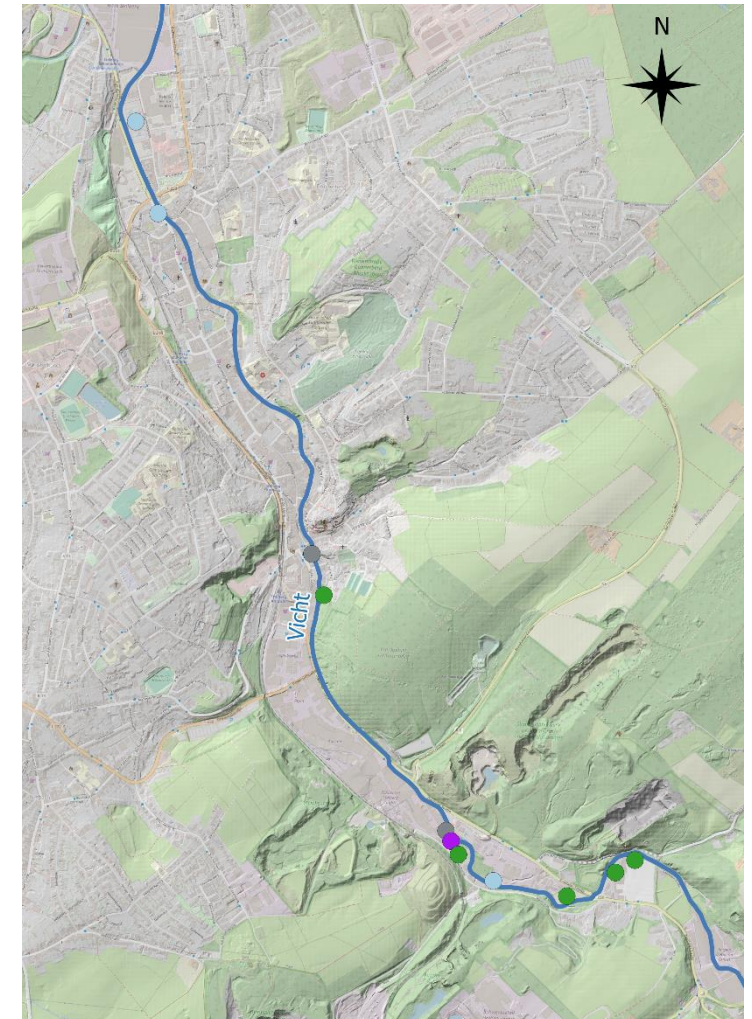
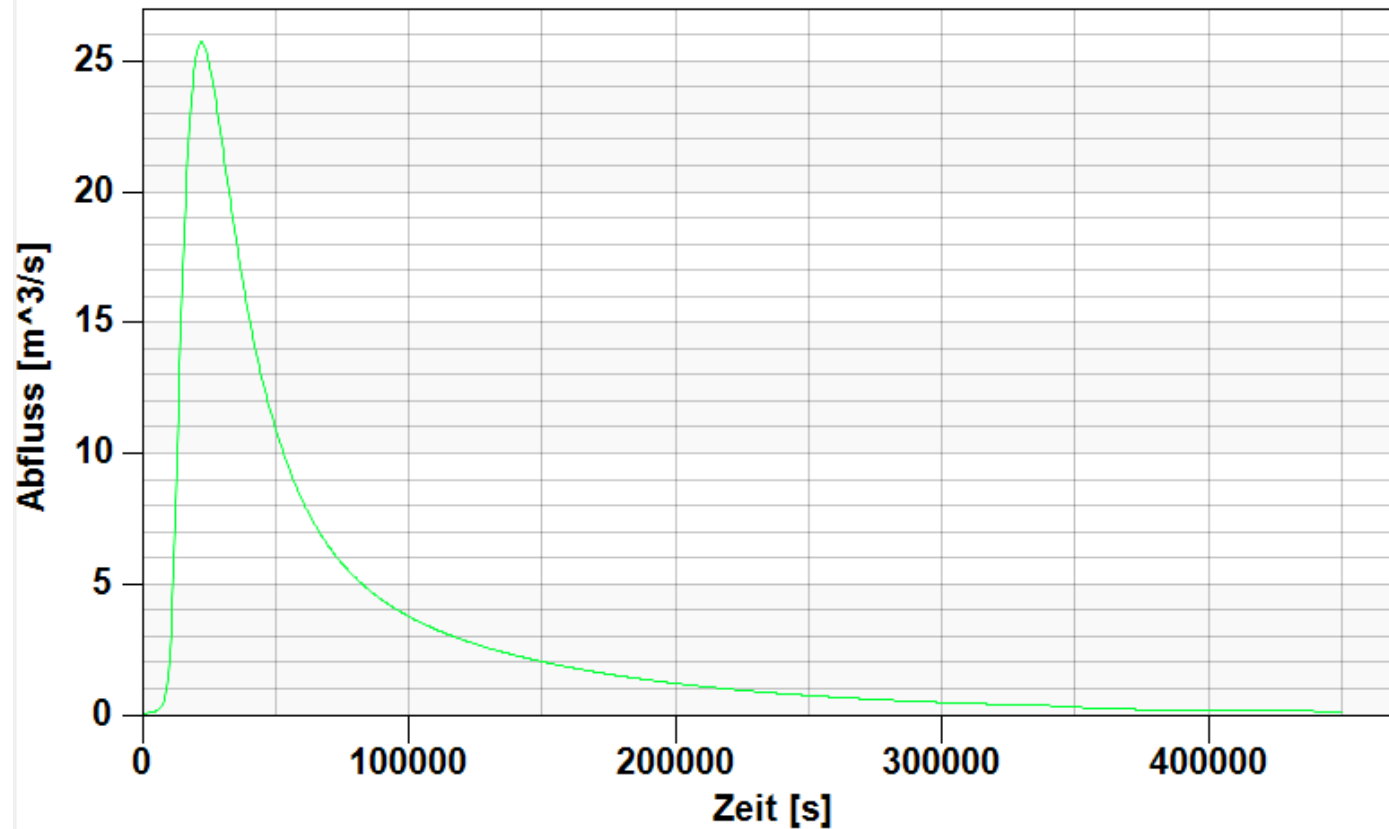
- affected buildings without measure: 1,063



- affected buildings with measure: 799

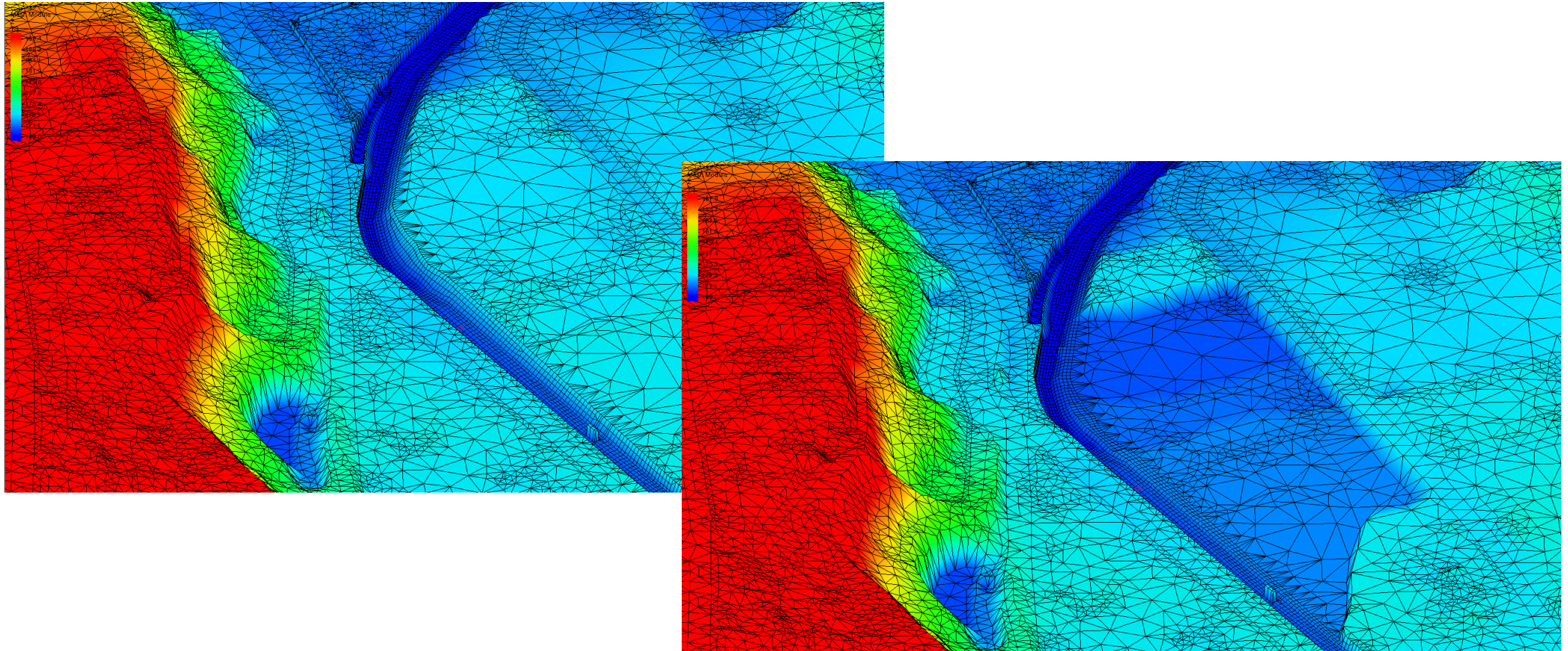


discharge at a tributary point



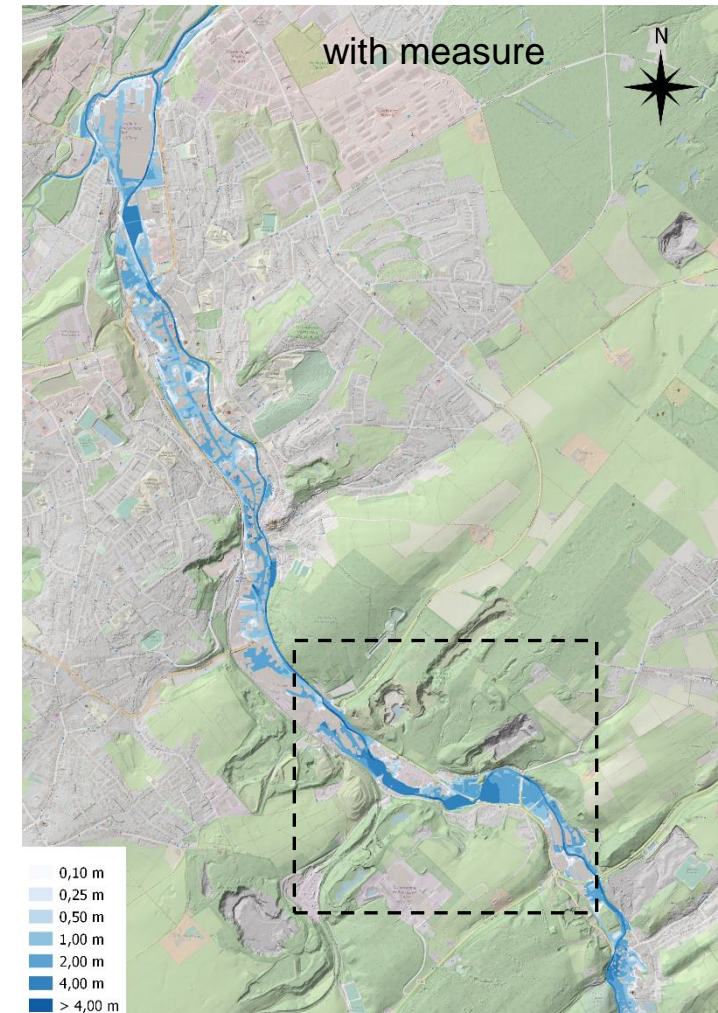
Results

- FLOOD PROTECTION MEASURES IN STOLBERG -



Results

- FLOOD PROTECTION MEASURES IN STOLBERG -



Results

- FLOOD PROTECTION MEASURES IN STOLBERG -



difference of the measures:

• floodplain without measure: 2,084,643 m² (2.084 km²)

➤ difference von 54,795 m²

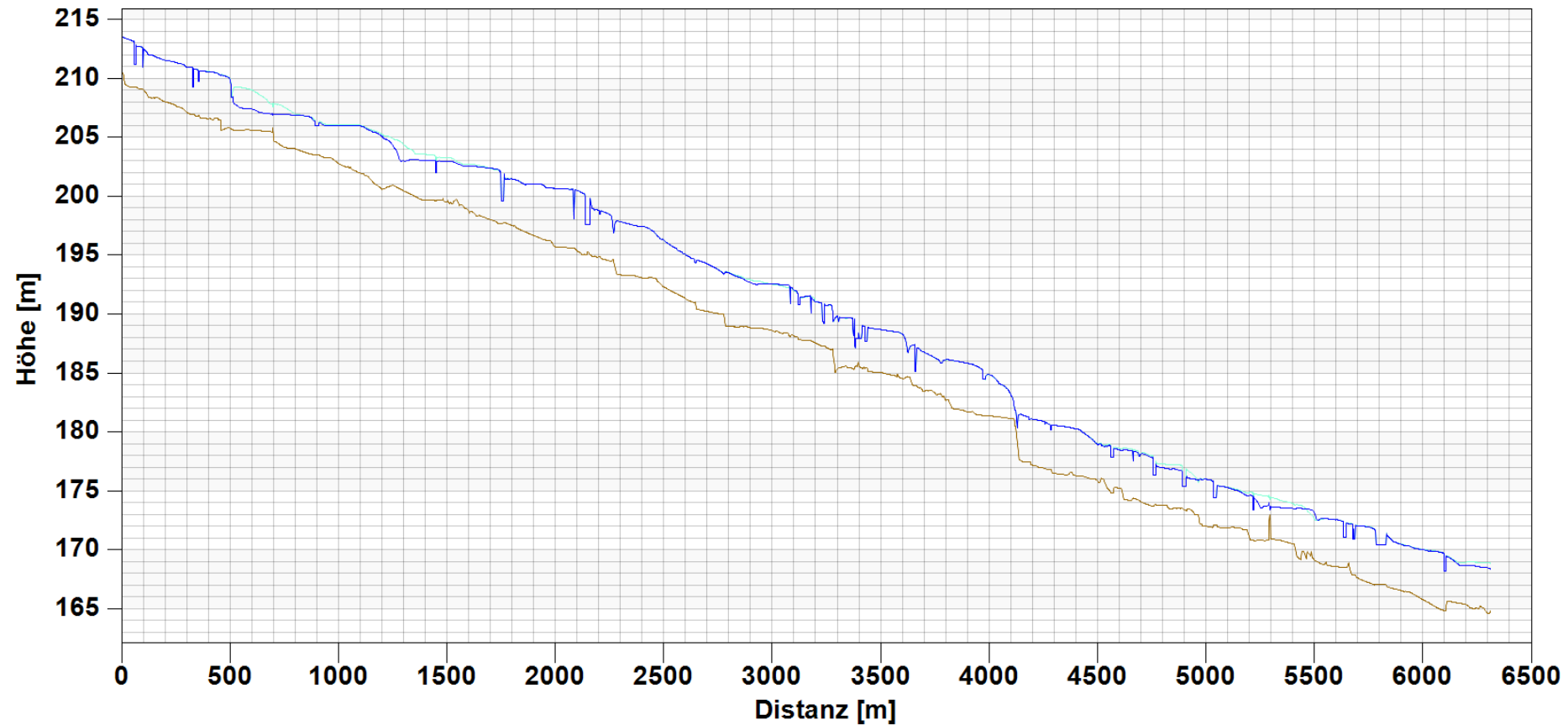
• floodplain with measure: 2,029,848 m² (2.029 km²)

• affected buildings without measure: 2,027

• affected buildings with measure: 1,978

Results

- FLOOD PROTECTION MEASURES IN STOLBERG -

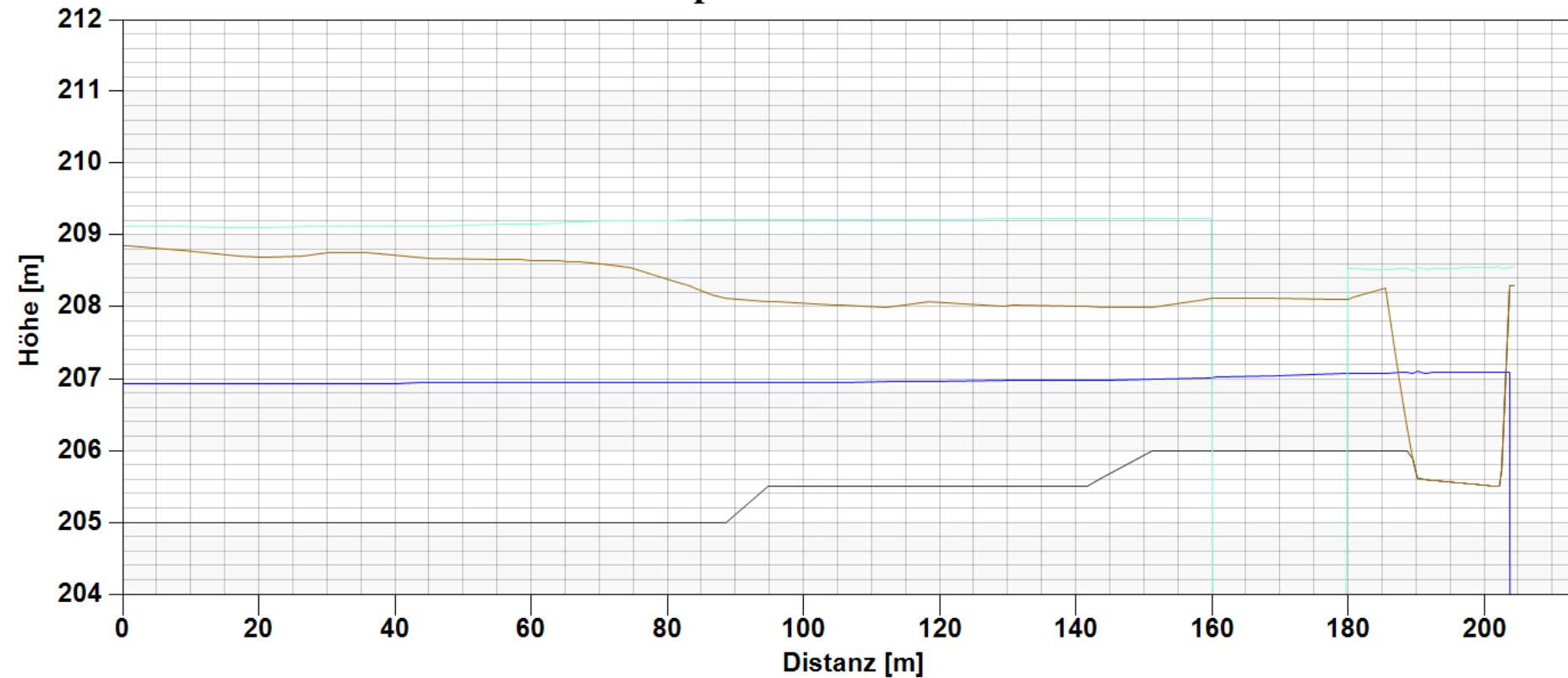


Arc 1, Z

Arc 1, Merged (5)\wspl_max_Merged

Arc 1, Merged (3)\wspl_max_Merged

comparison - water level



Arc 1, Merged (3)\wspl_max_Merged

Arc 1, Merged (3)\Z

Arc 1, Merged (5)\wspl_max_Merged

Arc 1, Merged (5)\Z



Thank you for your attention