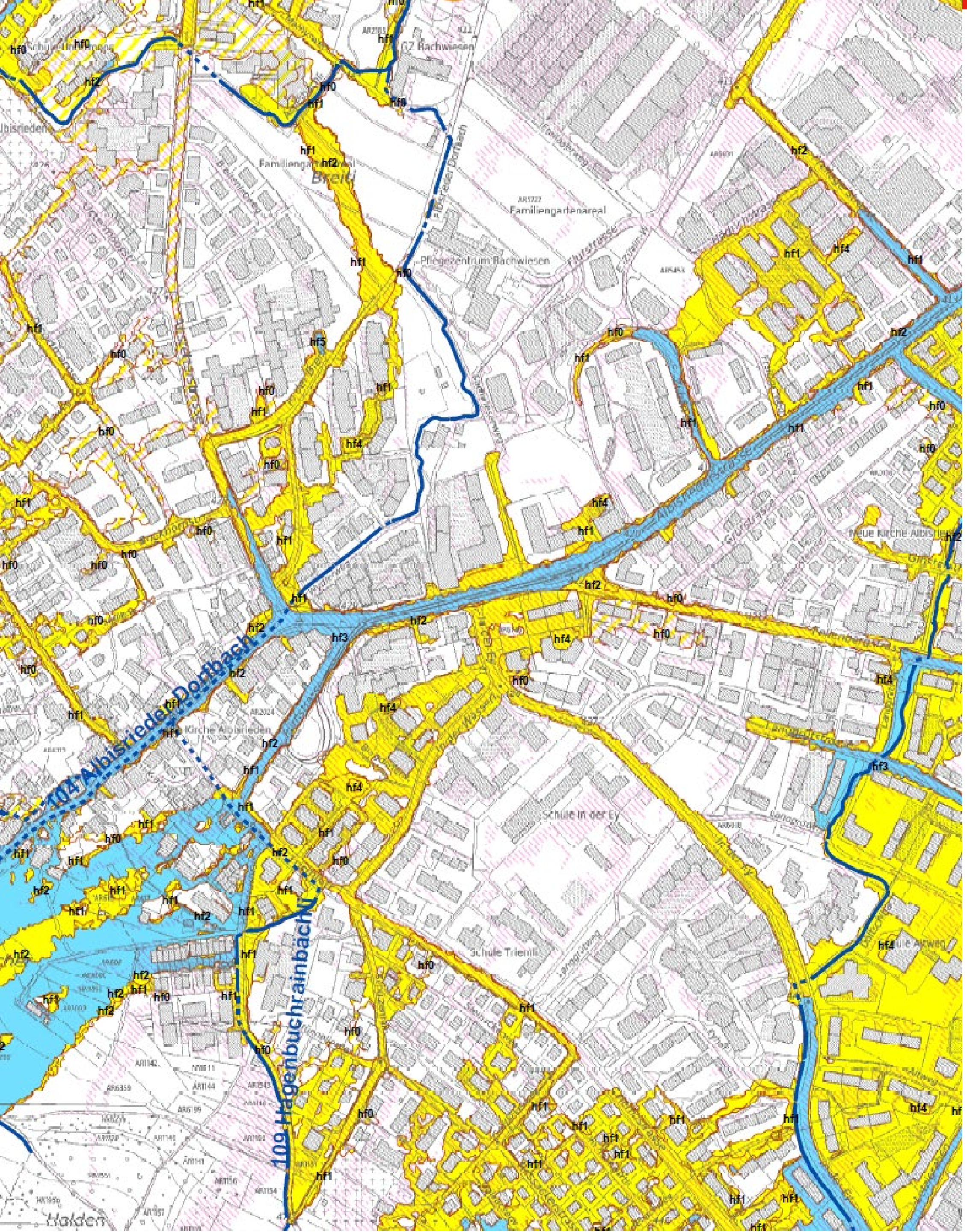
GEOTEST

Hydrodynamic 2D-models as a basis for the elaboration of hazard maps in urban areas

26.01.2023 | Basement User Meeting 2023

Andreas Sutter



Agenda

→ Introduction

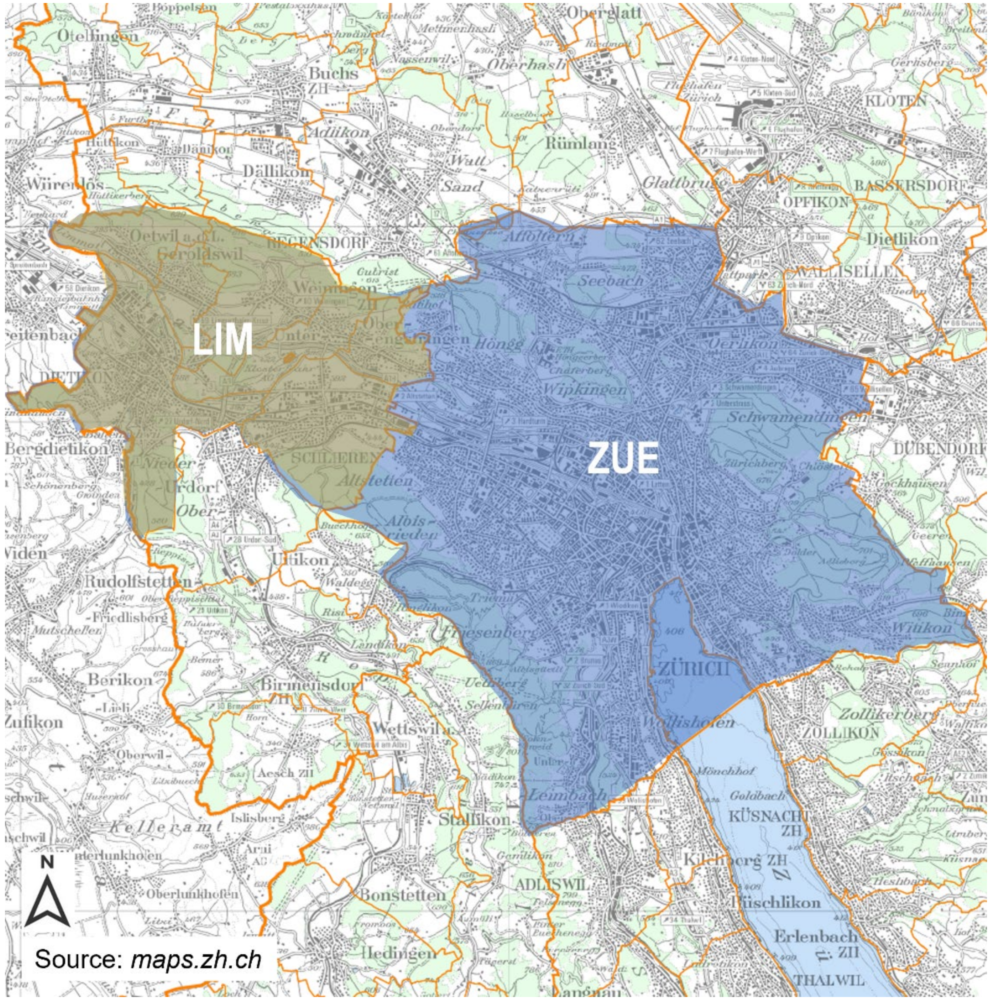
→ Examples

→ Control of the Flow Distance of a Simulation

→ «Our» solution

→ Discussion

Introduction



Source: *maps.zh.ch*

→ GEOTEST AG was able to carry out two major hazard map revisions in the canton of Zurich

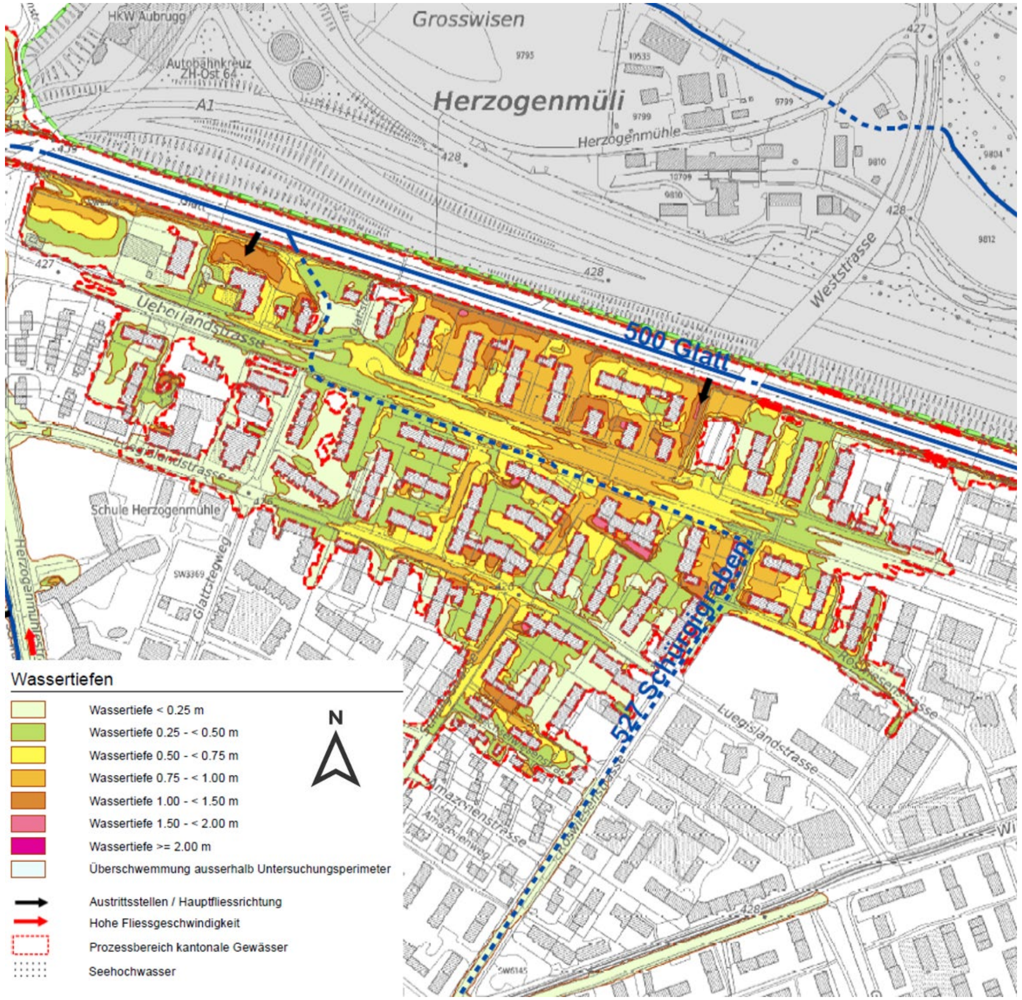
- Limmattal (7 municipalities, West of Zürich)
- City of Zürich

→ Simulation of > 500 weak points with multiple recurrence periods (~ 1500 runs) using Basement v3.1

- LIM: 13 Meshs
- ZUE: 23 Meshs

→ generated from simplified AV-data and DTM (Kt. ZH)

Introduction



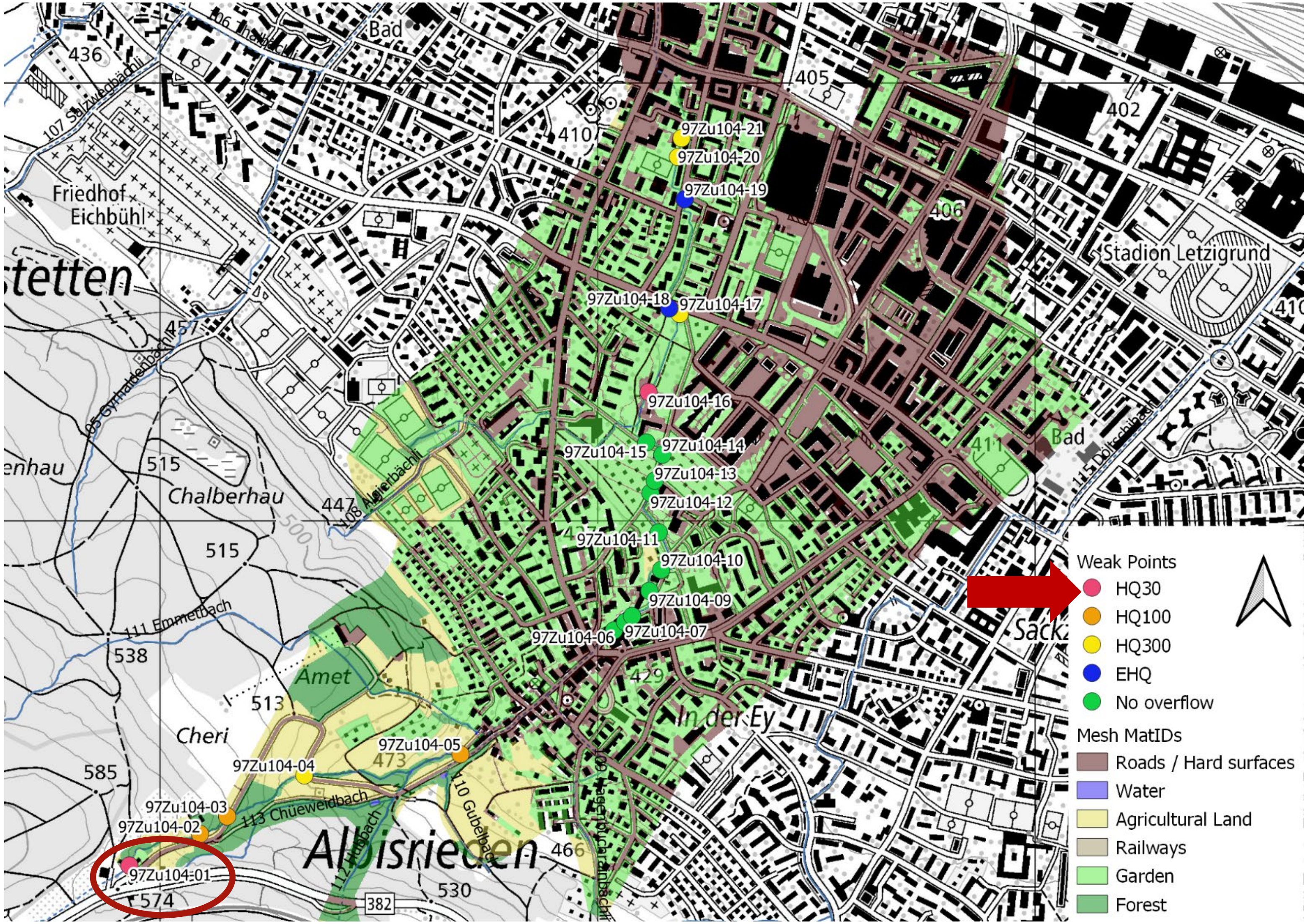
→ Hazard map scale 1:5’000, requires some detail but with limits

→ Complex data model

→ *Our goal*: reduce manual work per simulation / weak point to the necessary minimum using a high degree of automatisation

→ *Problem*: In flat, urban areas (i.e. Zurich Albisrieden / Altstetten), very large flooded areas result in the simulations even with rather small peak discharges

Example Albisrieden – Setup



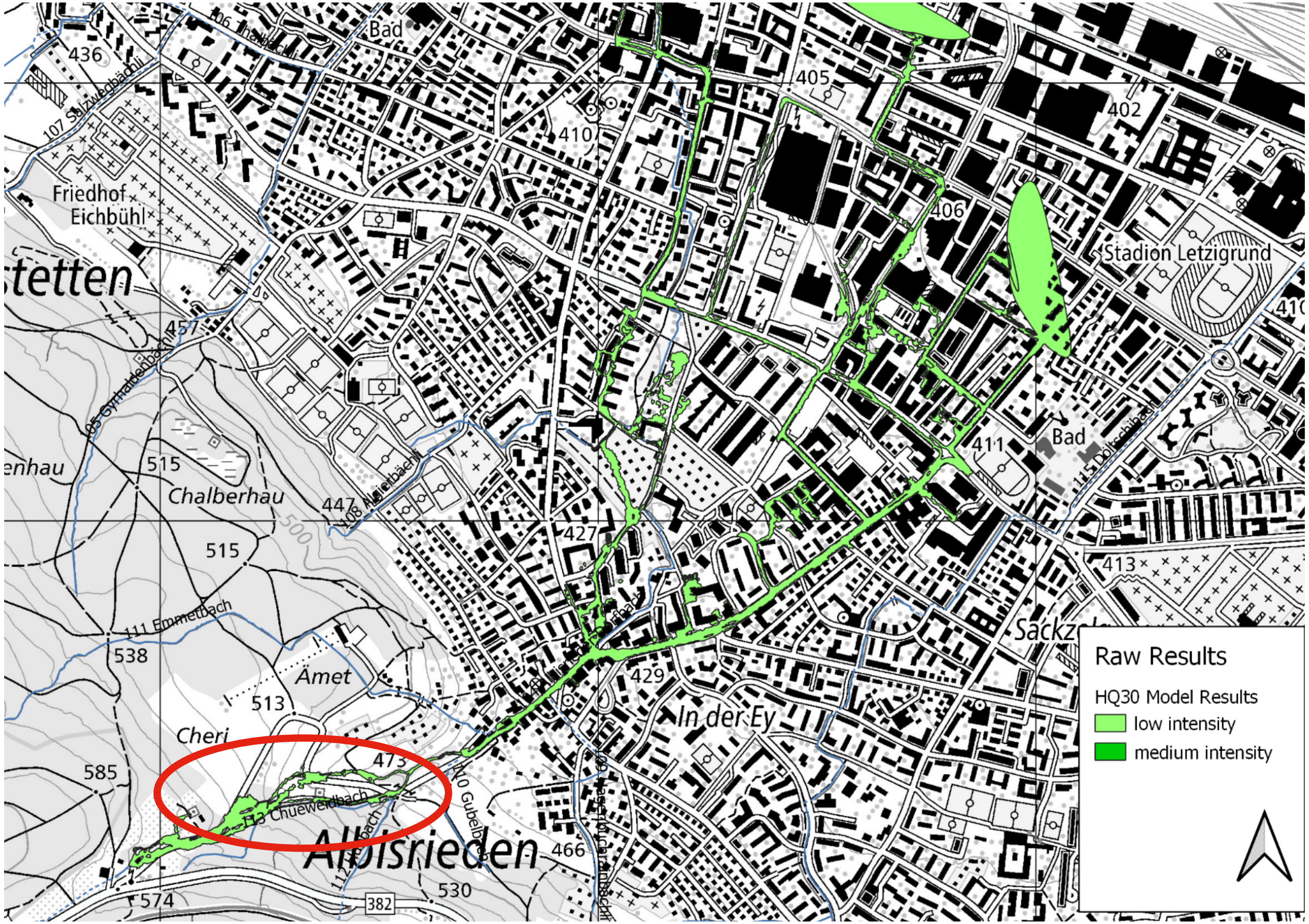
Hydrograph

Peak Discharge HQ30:
- 104-01: **1.02 m³/s**

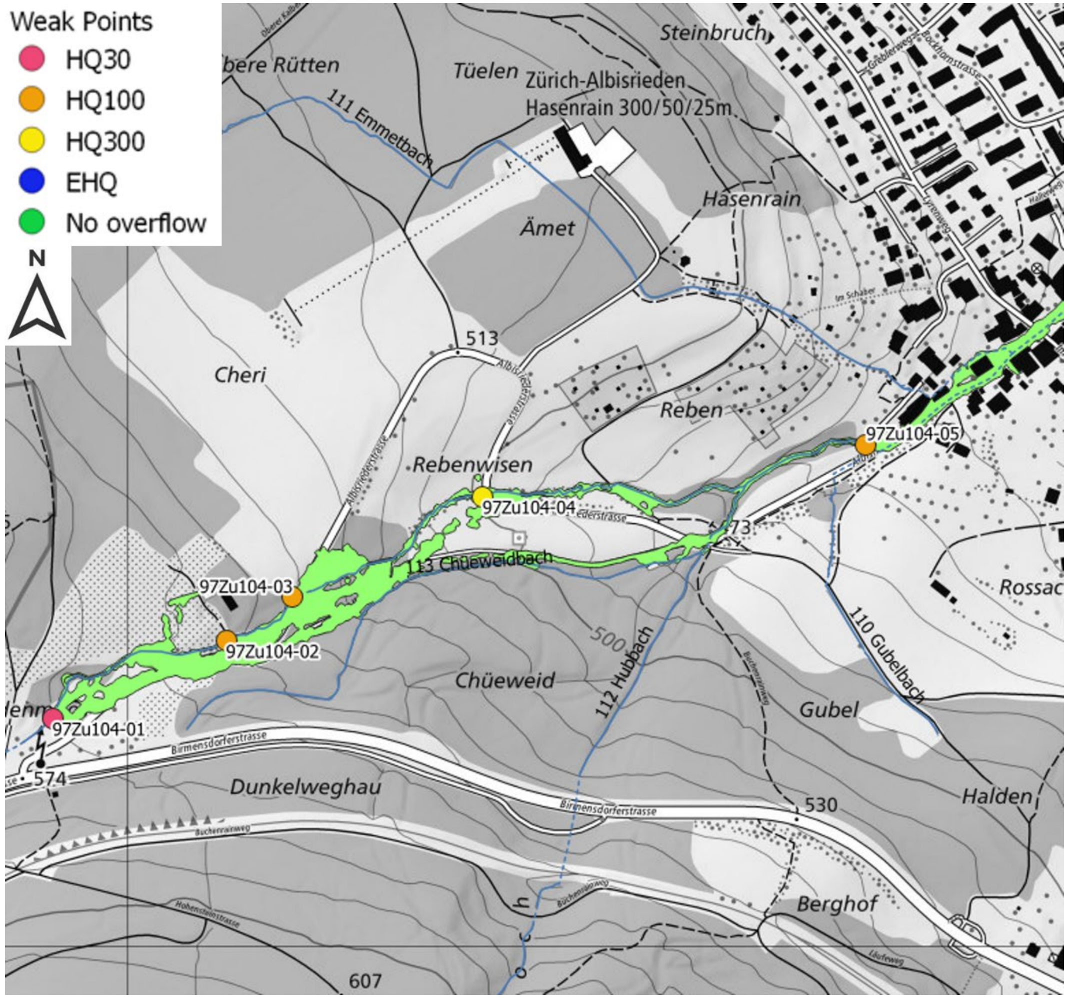
Peak Duration: 300 s

Total Hydrograph: 3 h

Example Albisrieden – Raw Results



Example Albisrieden – Raw Results



- No «functioning» river network:
  - Water cannot properly be deviated / drained
  - Water that flows back into the river will overflow again → (*gross principle / «Bruttoprinzip»*)
- No losses in the model:
  - missing infiltration and storage
  - no linkage to sewage system
  - buildings are cut out
- Are there other ways to control the flow distance of a flood?

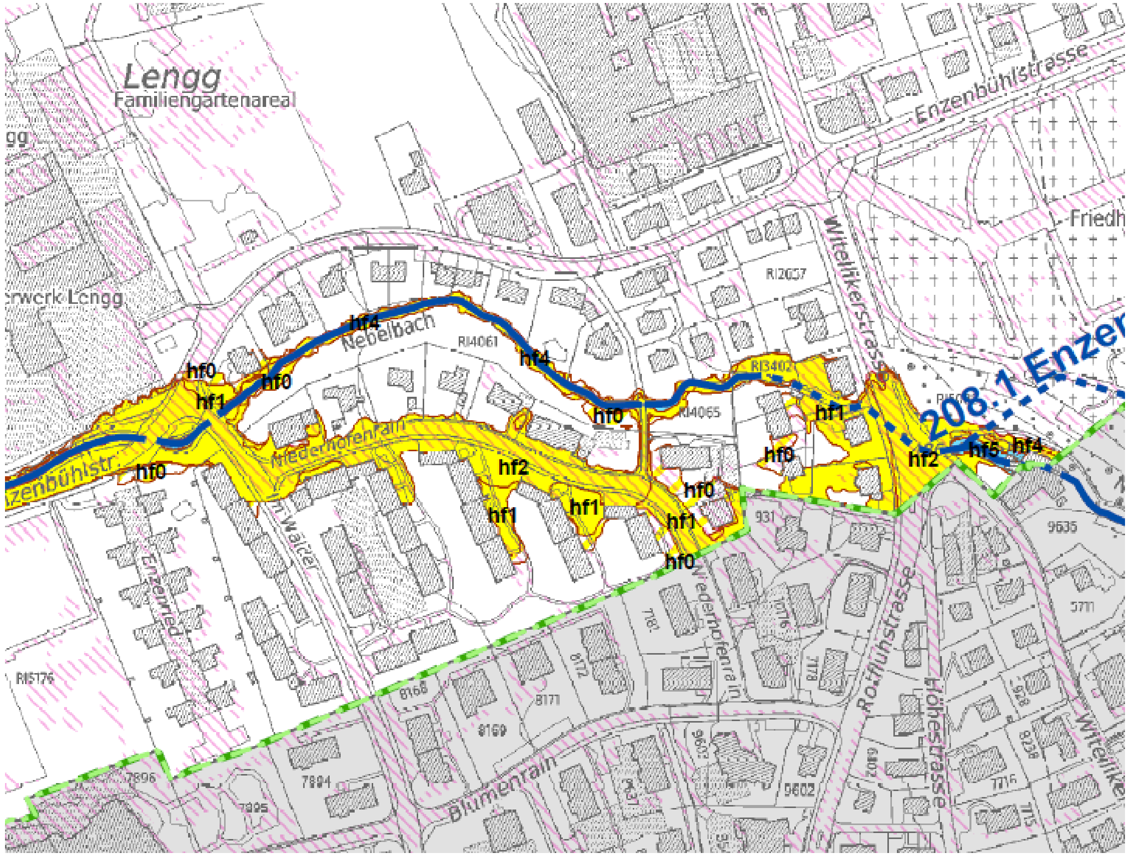
Gross Principle

Methodological principle (project specification): each weak point is treated invidually.

- HQs / hydraulics / scenarios (clogging / aggradation)

→ Water leaving the river at a weak points upstream is *included* in the calculations of a weak point downstream.

- *Advantage*: If a weak point is resolved (more water stays in the river), the hazard map remains valid.
- *Disadvantage*: Rather pessimistic approach for certain areas.



Control of the Flow Distance

«minimum water depth» :

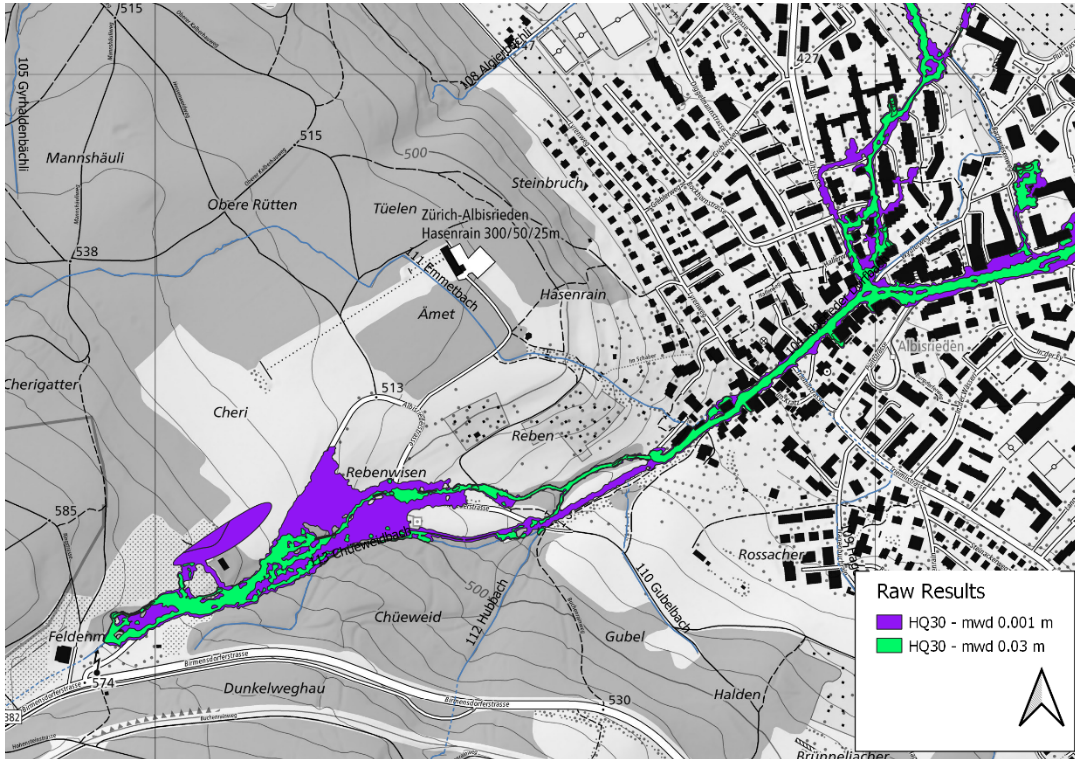
*"Every cell with **water depth below this value** will be **treated as dry** and **no fluxes** will be **calculated** until the cell reaches a water depth above the minimum_water_depth. Increasing this parameter leads to a more stable simulation with the prize of reduced accuracy and vice versa."*

→ technically, a higher value also reduces the flow distance / reach of the flood within the simulation

Postprocessing:
point clouds → defined cut-off value 0.01 m → interpolation → smoothing → manual editing

Sinks:
remove wat[illegible] in a controlled manner → globally on MatID / point sink → many [illegible]ties / work [illegible]igh

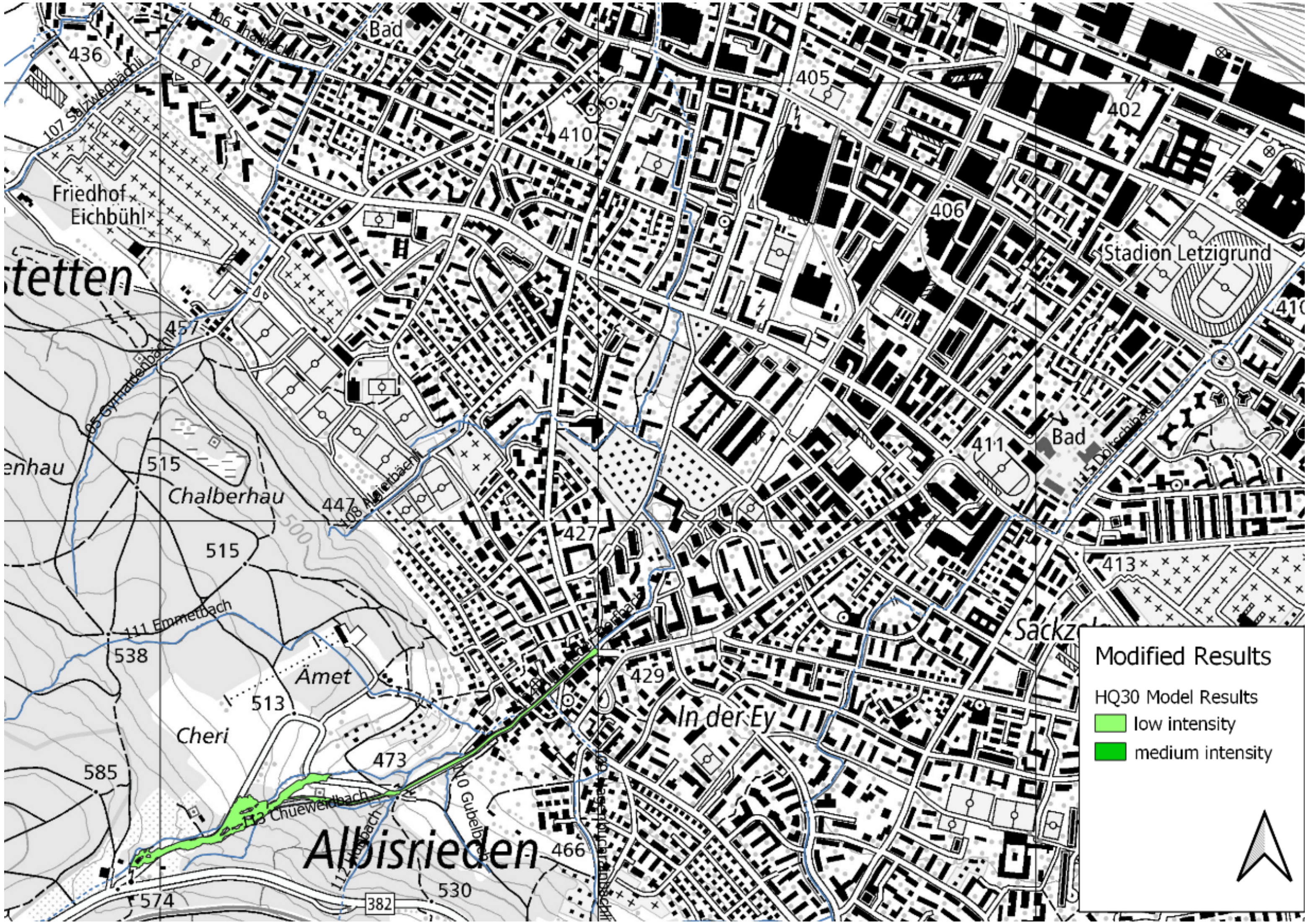
Control of the Flow Distance – effect of minimum water depth



Control of the Flow Distance – effect of minimum water depth

Low «mwd»	High «mwd»
More accurate	Less accurate
Less stable	More stable
Flow areas connected	More frequent «islands»
Requires bigger effort for postprocessing	Quick detection of more likely flow paths
More suited for small-scale problems	Less suited for small-scale problems

Our solution



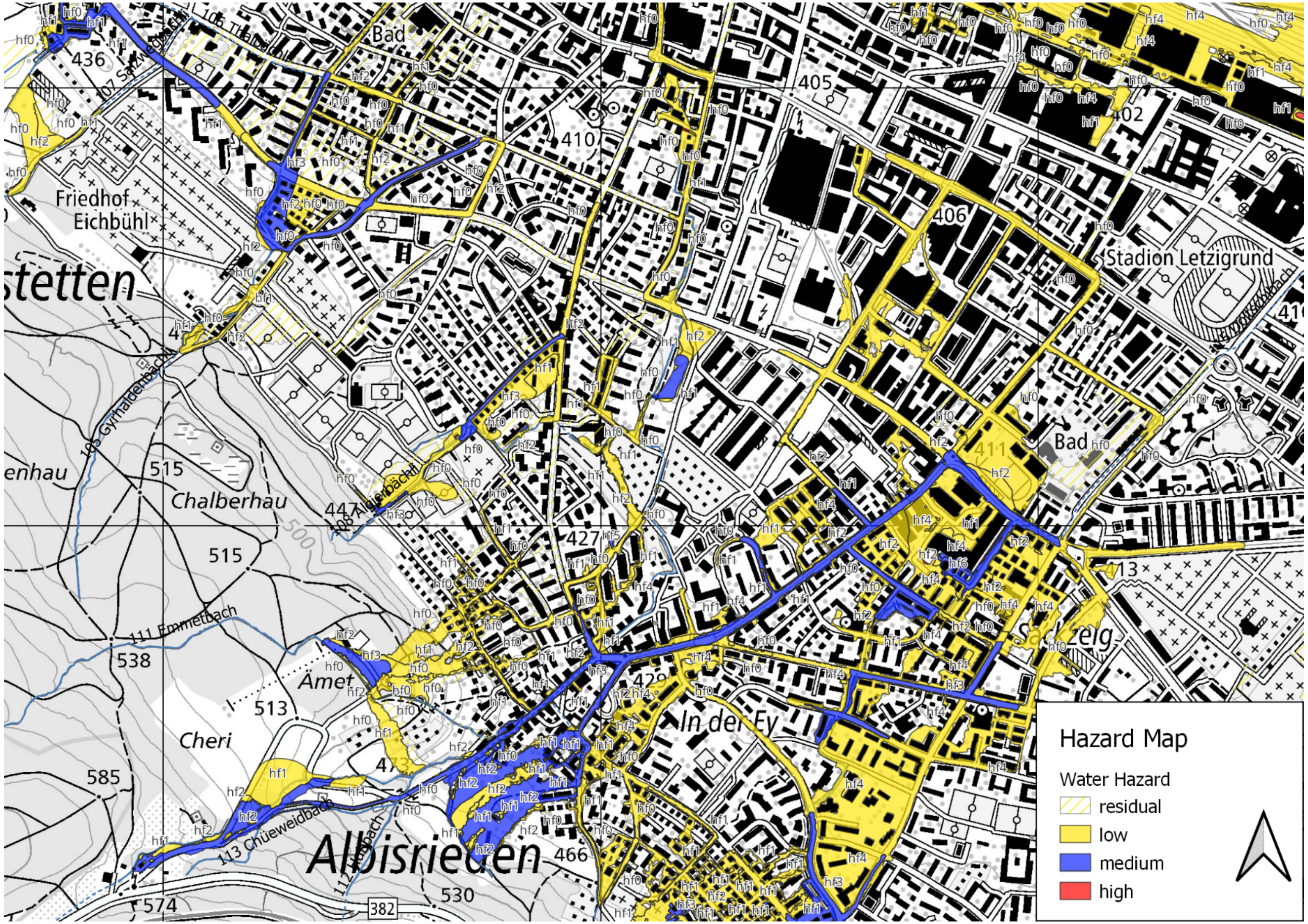
Individual Runs:

- «minimum water depth» at default value of 0.01 m
- Focus on field work, manual editing and postprocessing routine

Then:

- Stacking up all runs per HQ and river
- Generation of Hazard map with all HQs and all rivers

Our solution



Individual Runs:

- «minimum water depth» at default value of 0.01 m
- Focus on field work, manual editing and postprocessing routine

Then:

- Stacking up all runs per HQ and rivers
- Generation of Hazard map with all HQs and all rivers

Our solution - conclusions

- Automatisation has its limits.

- In our perimeters, the resulting flooded areas mainly had to be delimited during **postprocessing** (and not through the model parametrisation).

- The default value of **0.01 m** for **minimum water depth** was suitable to our project requirements.

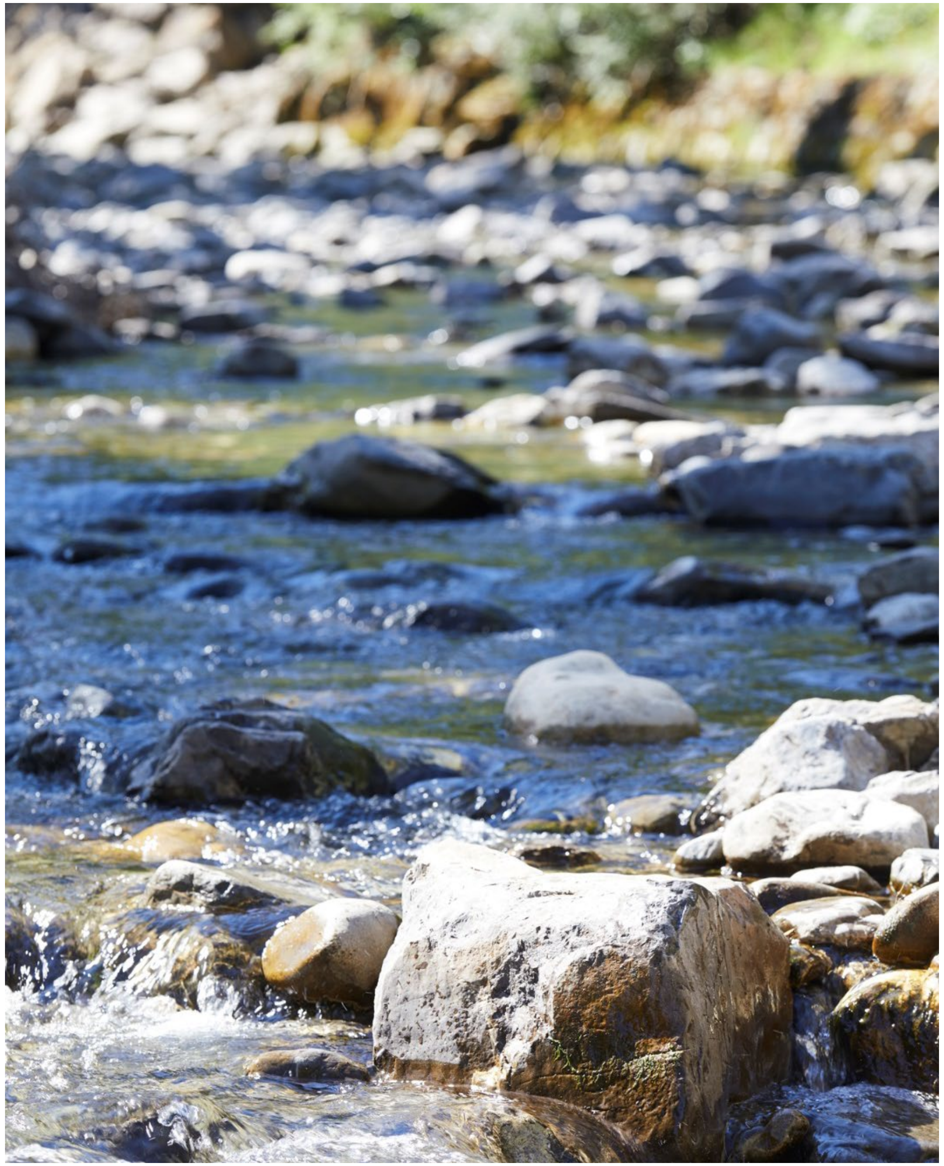
And further:

- Basement is a suitable model for the (semi-)automated simulation of large numbers of runs.
- The more you simplify the model, the more important the field work becomes. In urban areas, field work is key, no matter how good the simulation.

Discussion

- Have you ever encountered similar problems? How have you solved them?
- What value is ideal for «minimum water depth»? When should the default (0.01 m) be modified?
- Are there other suitable parameters to control the flow distance of a flood in flat (urban) areas?

Many Thanks!



Follow us:

in geotest-ch

YouTube Geotest