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# Management of dynamic river banks

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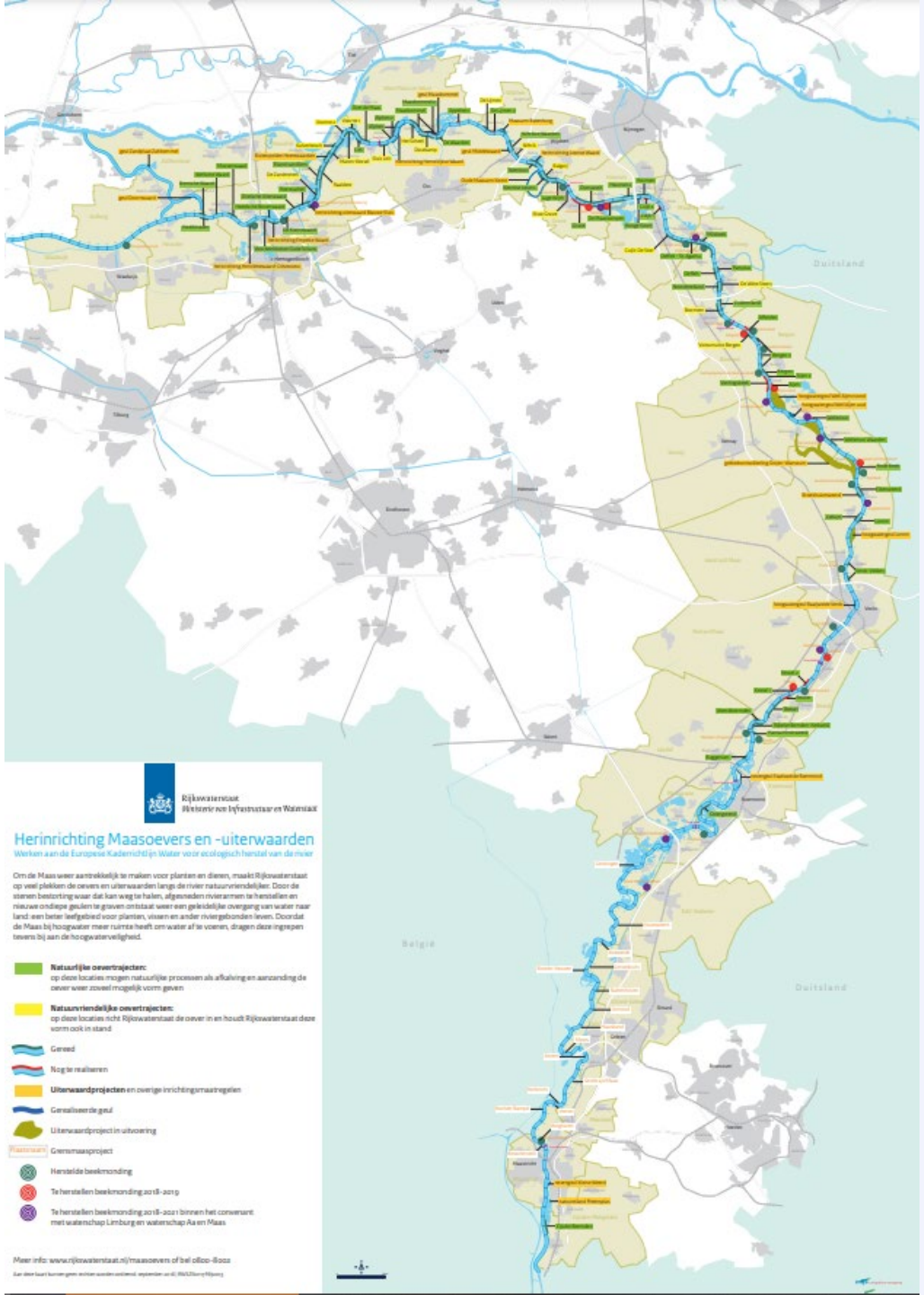
https://puc.overheid.nl/rijkswaterstaat/doc/PUC_635425_31/1/

# Nature friendly riverbanks

- Since 1990
- WFD: Improve natural/ecological quality of river banks
- Natuurvriendelijke oevers (NVO) - 120 km:
  - Partial or complete removal of bank protection
  - Partly excavated banks with under water protection

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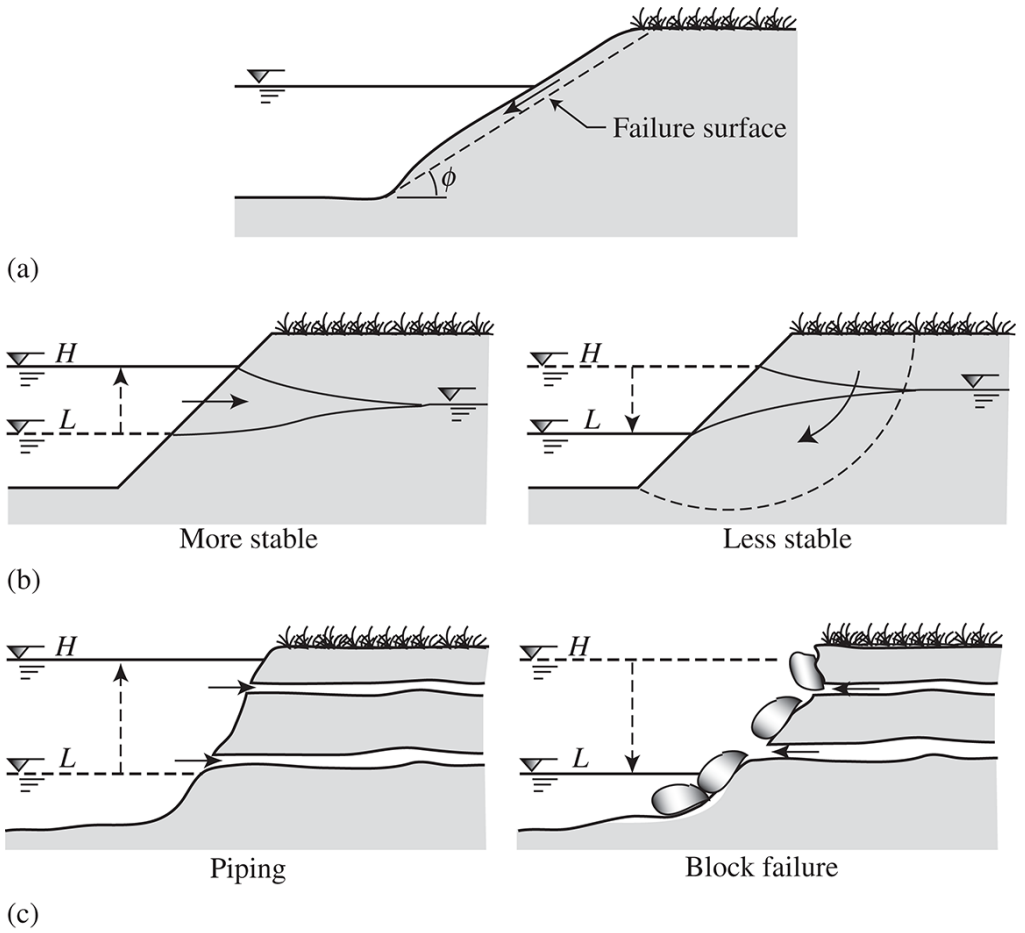
Buijse et al, 2019 Natuurvriendelijke oevers langs de Maas: toestand en trend na 10 jaar ontwikkeling

# Processes and factors of bank erosion

- **Bank scour**
  - Fluvial erosion
  - Wind waves
  - Ship waves (primairy, secundairy)
  - Turbulence
  - Groundwaterflow
- **Mass failure**
- Risk factors:
  - High flow velocities
  - Fast drop in water level
  - Shipping
  - Wind
  - River bank material and or vertical/horizontal heterogeneity
  - Absence of vegetation

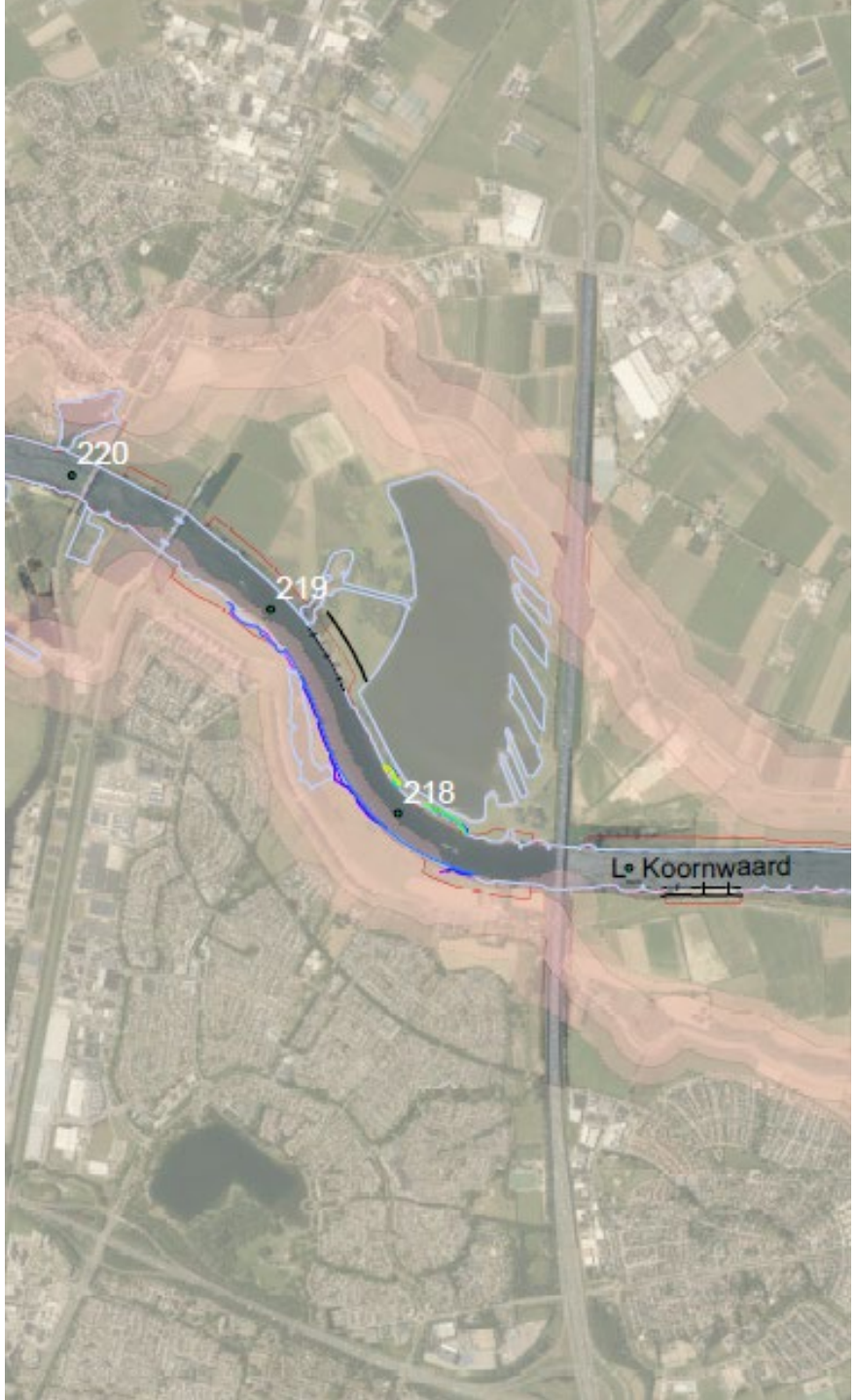



Julien, P. (2018). Riverbank Protection. In River Mechanics (pp. 230-259). Cambridge: Cambridge University Press. doi:10.1017/9781316107072.010

# The challenge

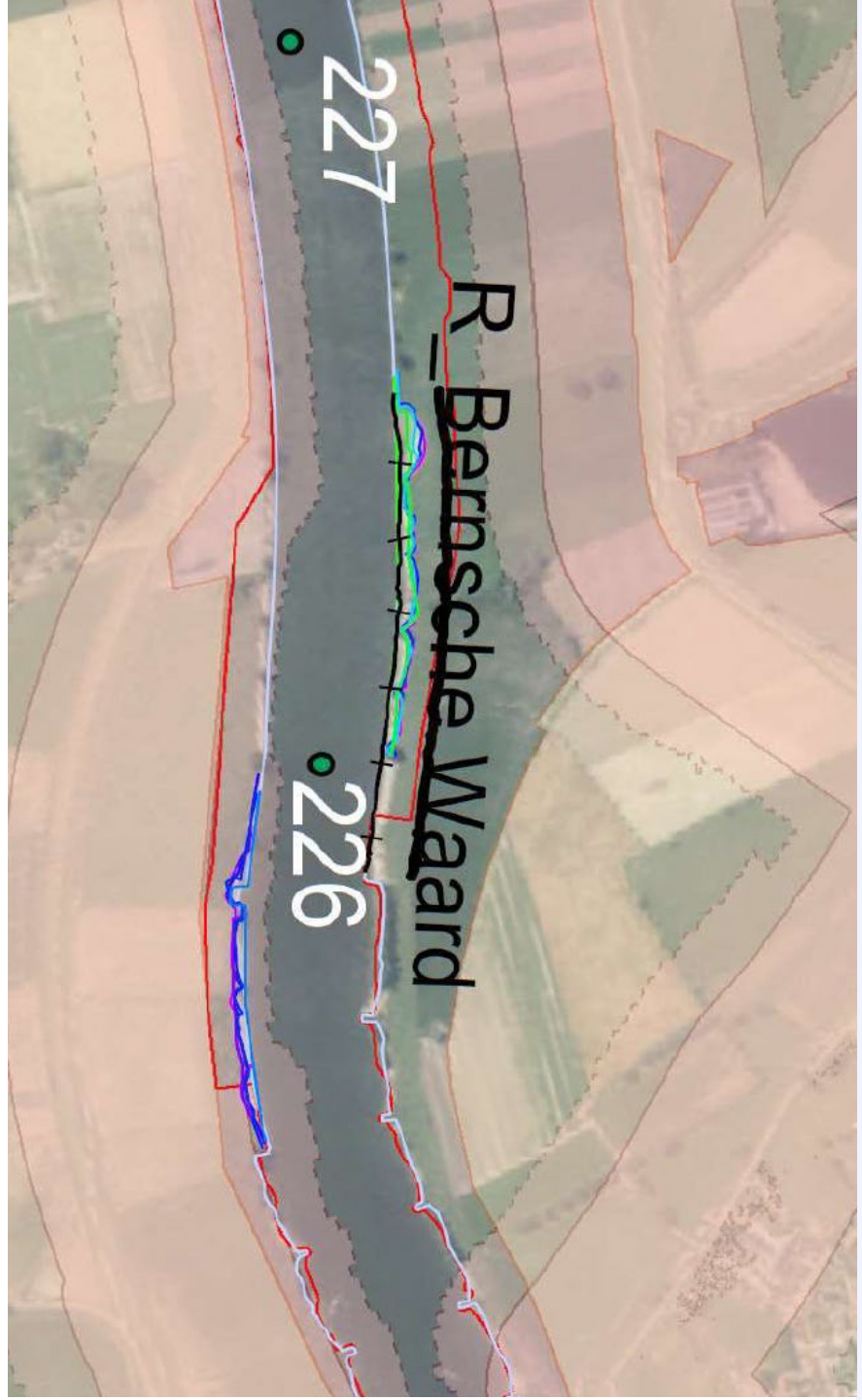
- Mapping banklines
- Prediction of bank erosion
- Management strategies
- Applicability in case studies
- Alternative design

- Focus on dynamic banks of the Meuse



# Mapping banklines

- **Former and current banklines**
  - Aerial photographs
  - Waterbodies OpenStreetMap
- **Boundaries for bank erosion**
  - No property of Rijkswaterstaat
  - “Signaleringslijnen”
  - “Keurzone van waterkeringen”
- **Prediction of future banklines**
  - Short-term: WAQBank
  - Long-term: EquiBank



# Prediction of bank erosion

**Evaluation and selection of methods**

- BEM
- WAQBank **-> Short-term (5 years)**
- SIREM
- Htrend
- Banklines
- Equibank **-> Long-term (50 years)**

Dr. Gonzalo Durò – PhD thesis
Bank erosion in regulated navigable rivers

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# Typical bank profile shaped by ship waves in a regulated reach of the Meuse river

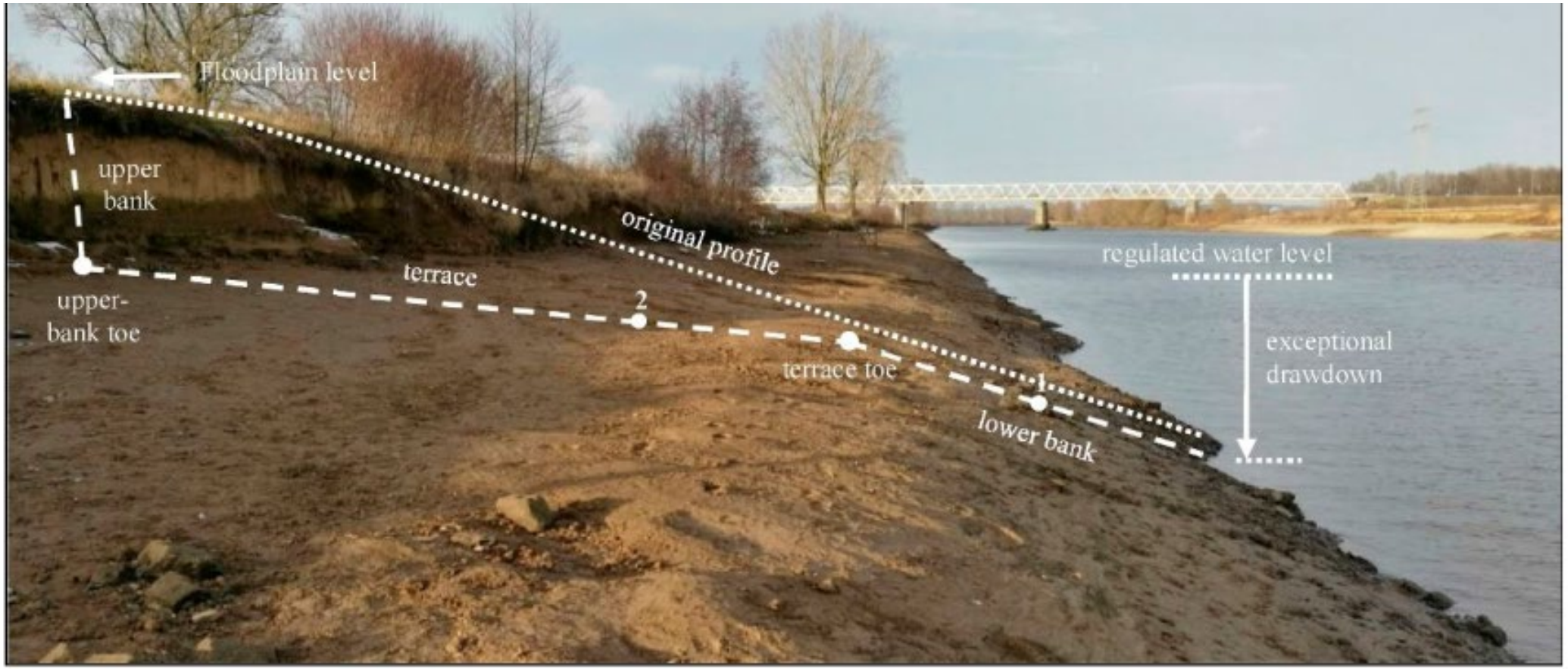


*Figure A-1. Features of a bank profile shaped by ship waves along a regulated reach of the Meuse River (km 154.1), visible after a ship accident against Grave weir (source: Duró et al., 2020b).*

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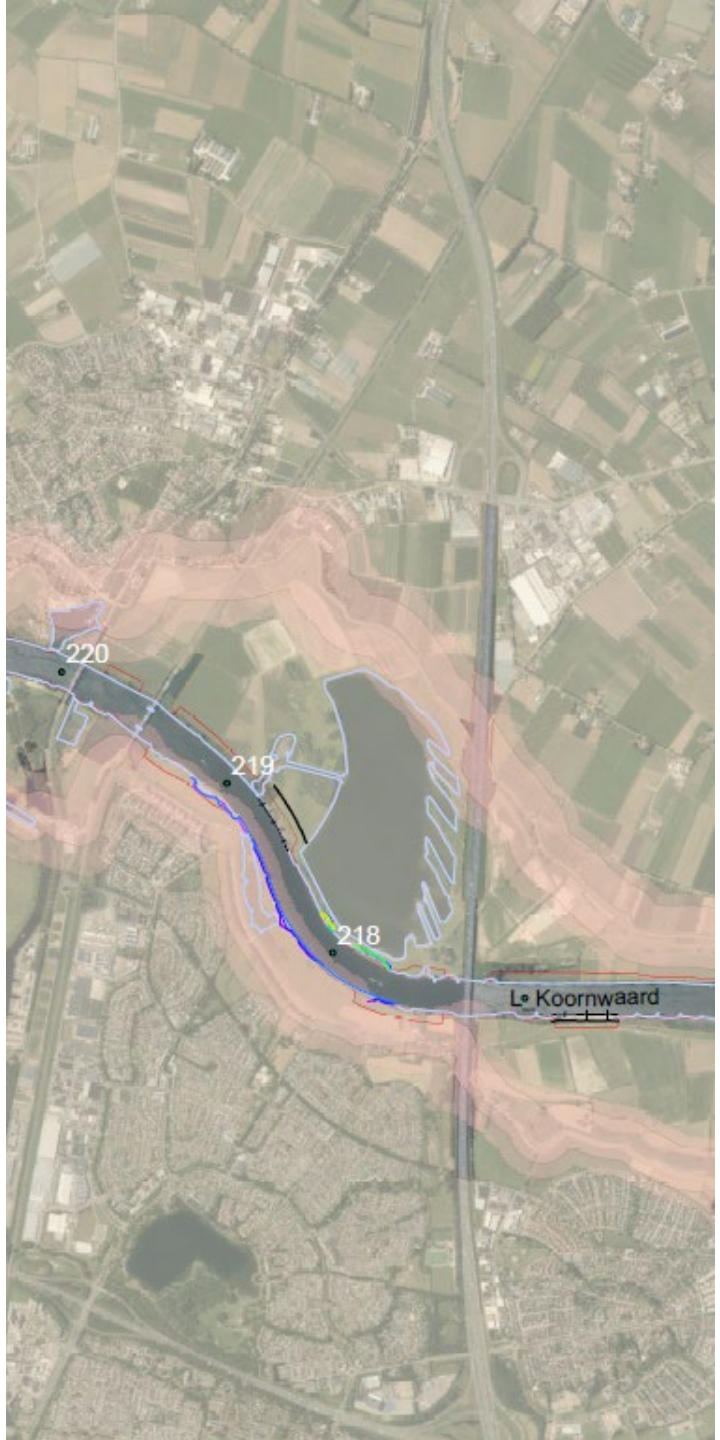
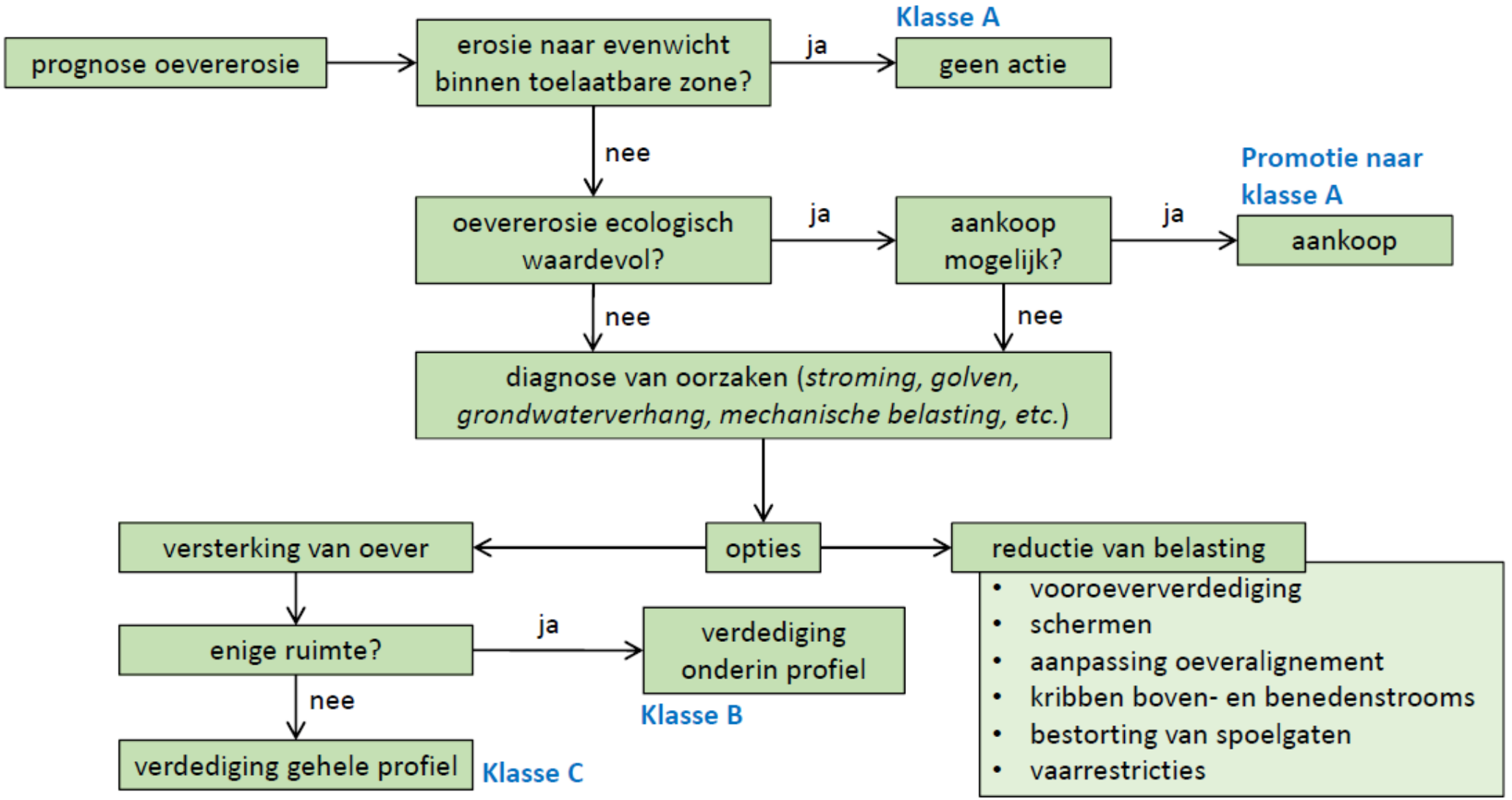
# Management strategies

- **Classification of banks:**
  - Class A: Banks with sufficient space for dynamic development towards equilibrium
  - Class B: Banks with limited space for dynamics
  - Class C: Banks without space for dynamics

- A bank can be promoted by purchasing ground
- Criteria: natural value of the bank



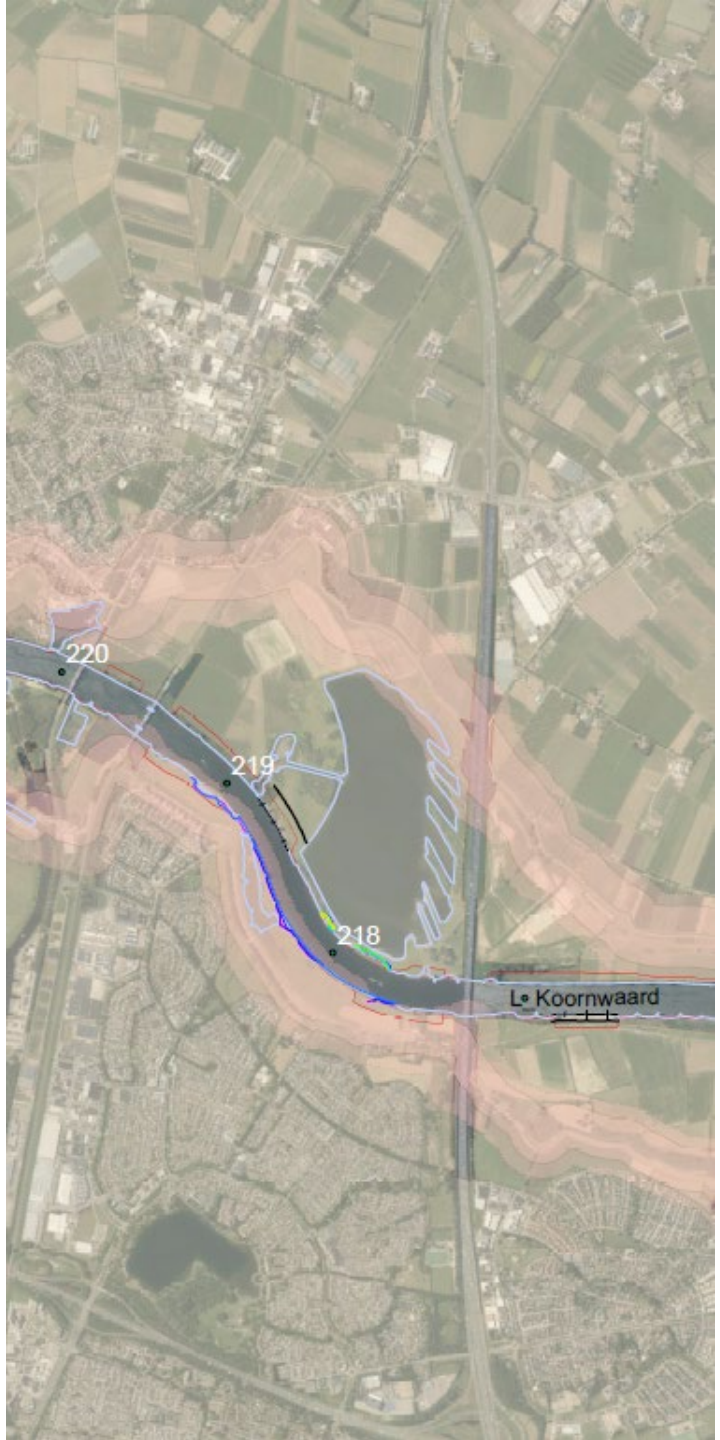
# Management strategies



# Case studies

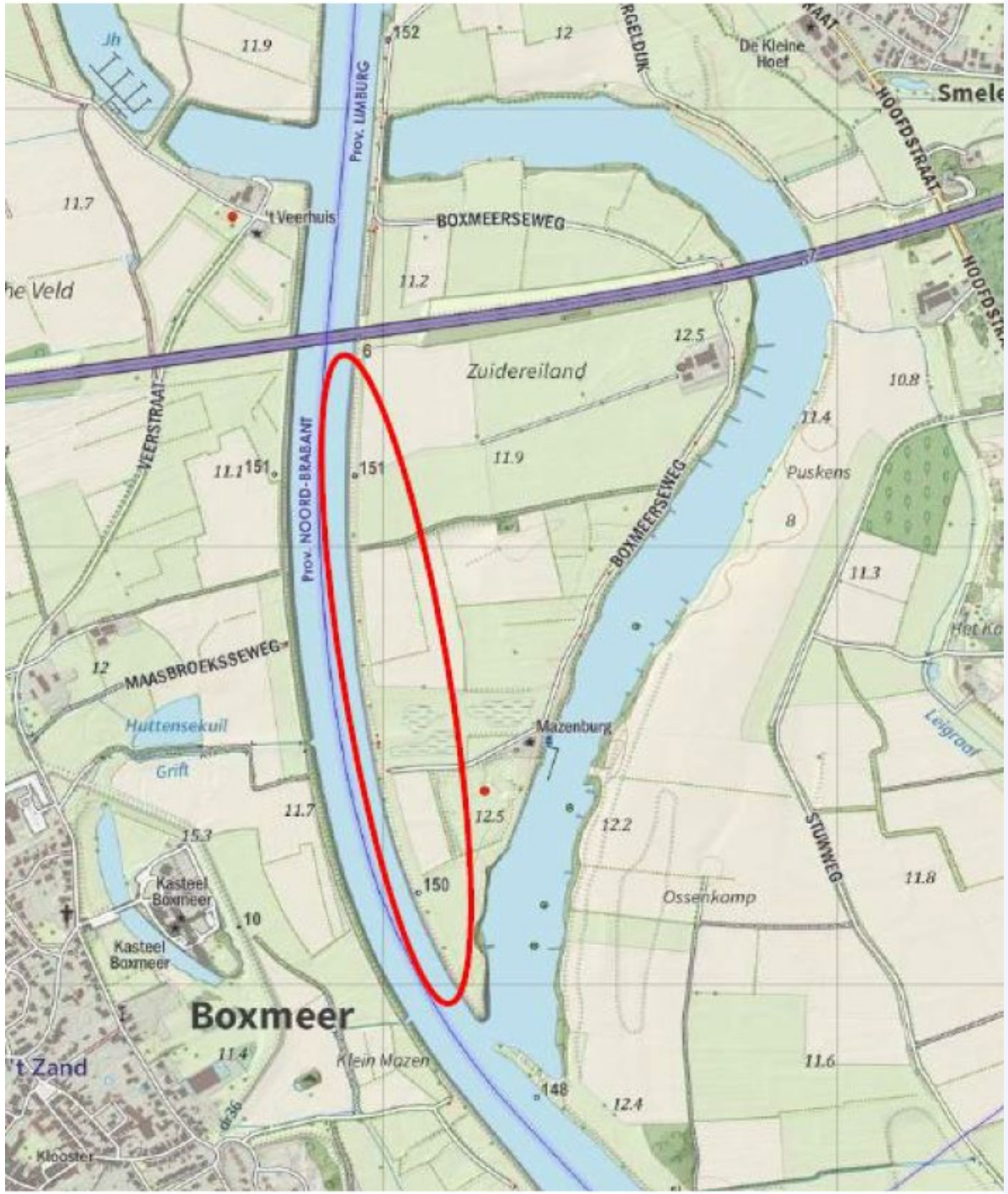
**Selected erosion hotspots:**

| Km | Oever | Naam |
|---|---|---|
| | | **Maas** |
| 151 | RO | Zuidereiland |
| 218.1-218.2 | RO | Hedelse Bovenwaard |
| 218.5-218.9 | LO | Empelse Waard |
| | | **Nederrijn** |
| 951 | LO | Pontwaard Vianen |
| | | **Waal** |
| 937 | LO | Gameren |



# Zuidereiland (rkm151)

- High bank (4 m above water level)
- Large rates of erosion expected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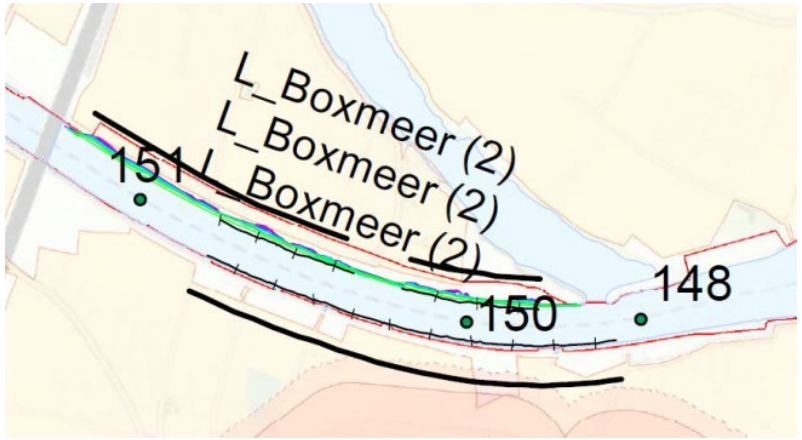
# Erosion 2010-2020

- Class B
- Land can be bought  -> class A
- Only clay -> no ecological value

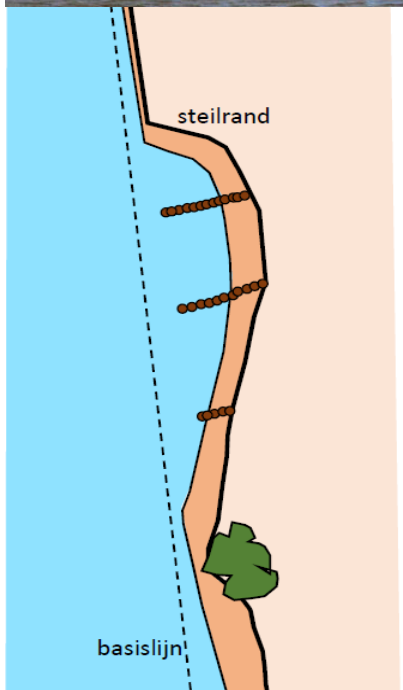


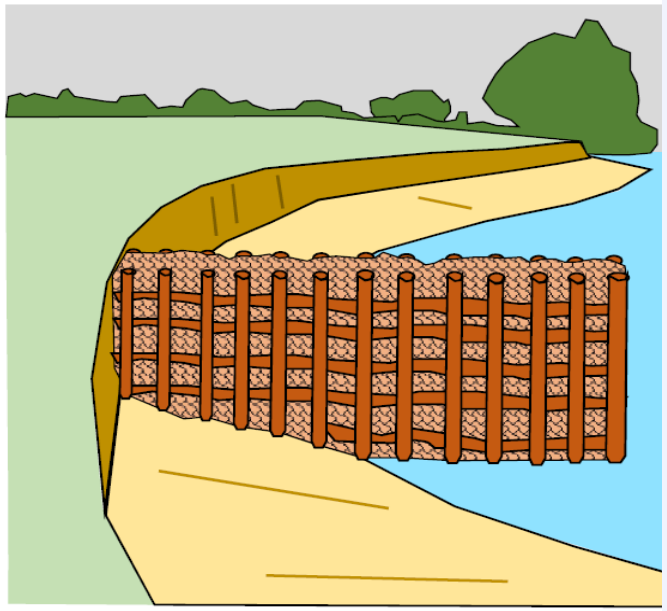

# Solutions

- Stabilize both the baseline and the steep edge
- Hard protection of the terrace
- Promote dense bank vegetation (reed or willows)

# Alternative

- Groyne-like constructions
  - Double rows of posts, stones, dead wood, vegetation

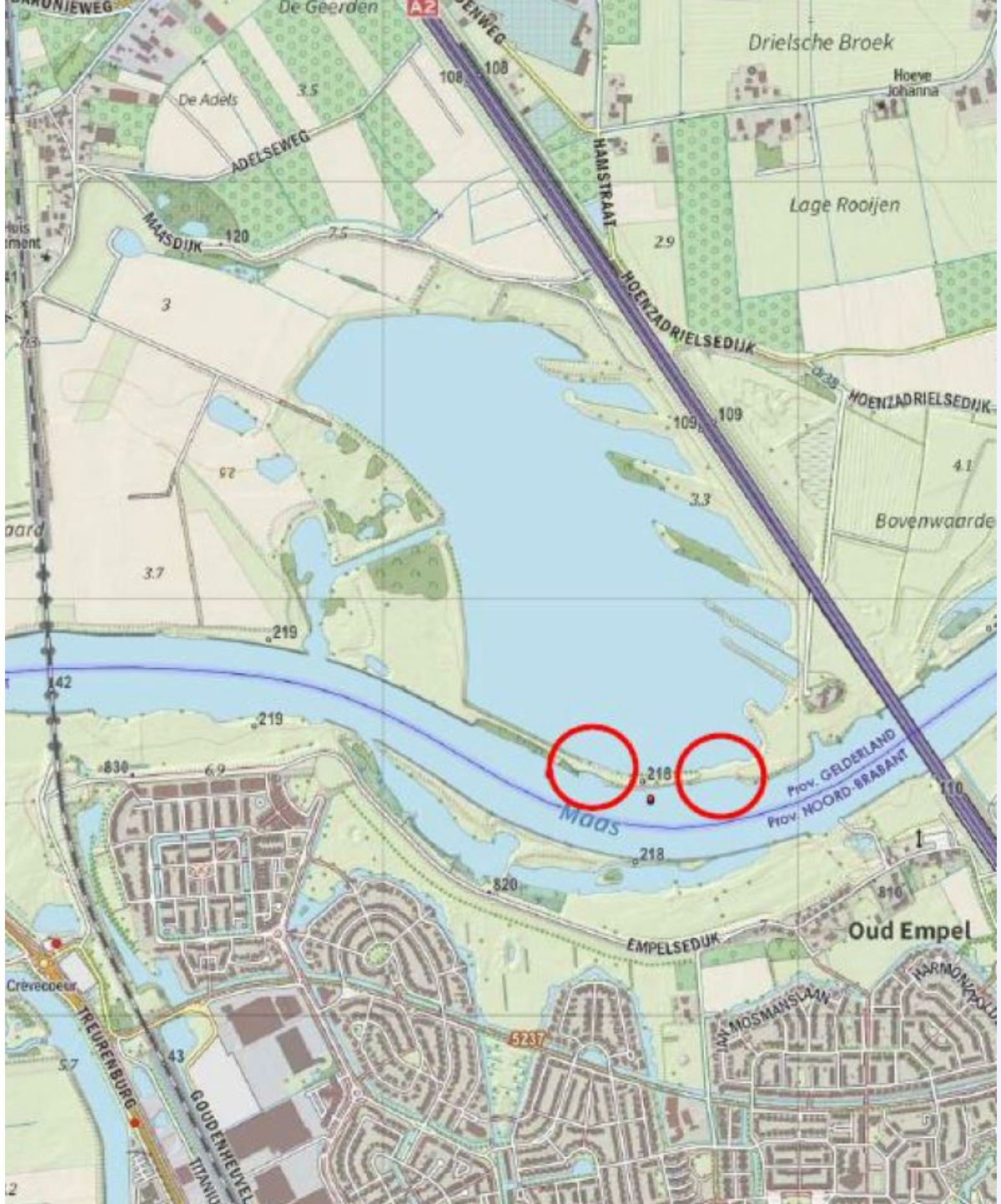


# Hedelse Bovenwaard (rkm 218)

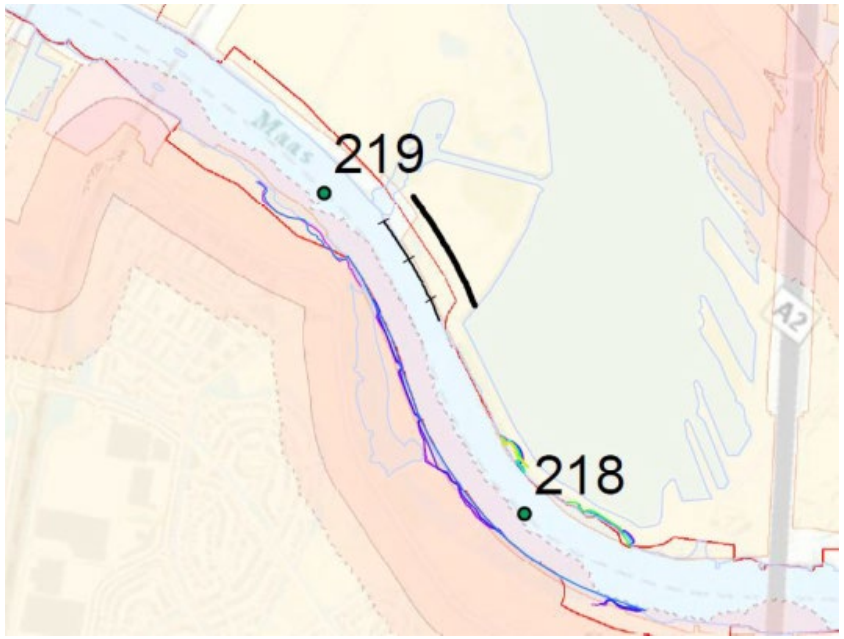
- High bank (3 m above water level)
- Bank not equal in height, locally lower
- Large rates of erosion expected


Hesp, 2020



# Erosion 2007-2020

- Bank not equal in height, locally lower
  -> overtopping
- Shipwaves





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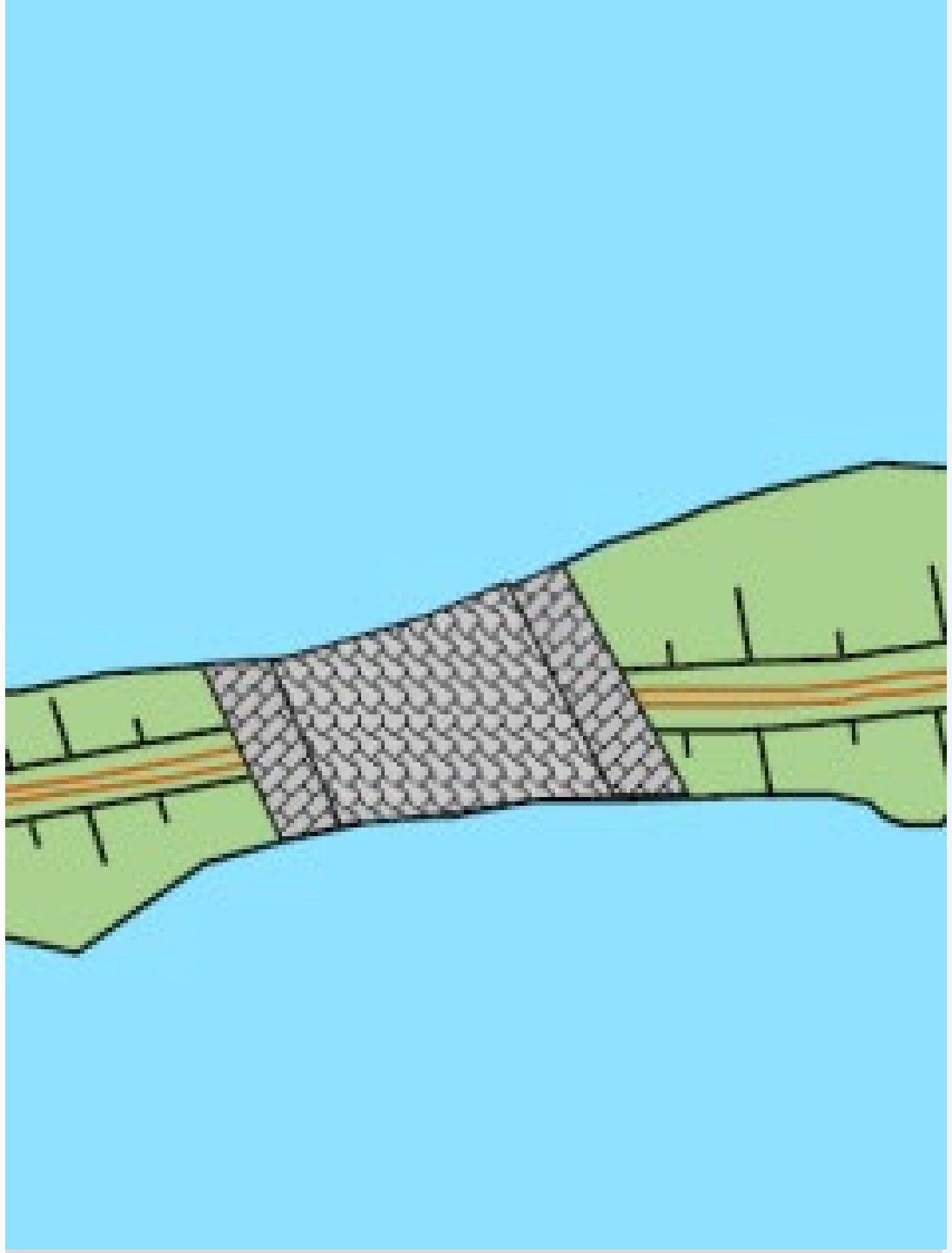
# Solutions

- Stabilize both the baseline and the steep edge
- Hard protection of the terrace
- Promote dense bank vegetation (reed or willows)

# Alternative

- Locally (lowered) protected place for overtopping
- Flatten the entire path/bank so it has the same height at all locations



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# Conclusions

- Along the river banklines and boundaries were mapped
- Prediction of bank erosion for ~100 dynamic banks
- Mapping former banklines for several highly dynamic banks
- Alternative designs for several erosion hotspots


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# References

**Report:** https://puc.overheid.nl/rijkswaterstaat/doc/PUC_635425_31/1/


- Buijse, T., G. Geerling, C. Chrzanowski, B. Peters & M. Dorenbosch (2019), Natuurvriendelijke oevers langs de Maas: toestand en trend na 10 jaar ontwikkeling. Deltares, Delft.
- Duró, G., A. Crosato, M.G. Kleinhans, J.A. Roelvink & W.S.J. Uijttewaal (2020b), Bank erosion processes in regulated navigable rivers. Journal of Geophysical Research: Earth Surface, Vol.125, e2019JF005441, DOI:10.1029/2019JF005441.
- Hesp, L. (2020), Oevererosie; Locaties. Presentatie 12 juni 2020, Rijkswaterstaat.