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WATER LEVEL UNCERTAINTIES DUE TO UNCERTAIN BEDFORM DYNAMICS IN THE DUTCH RHINE SYSTEM

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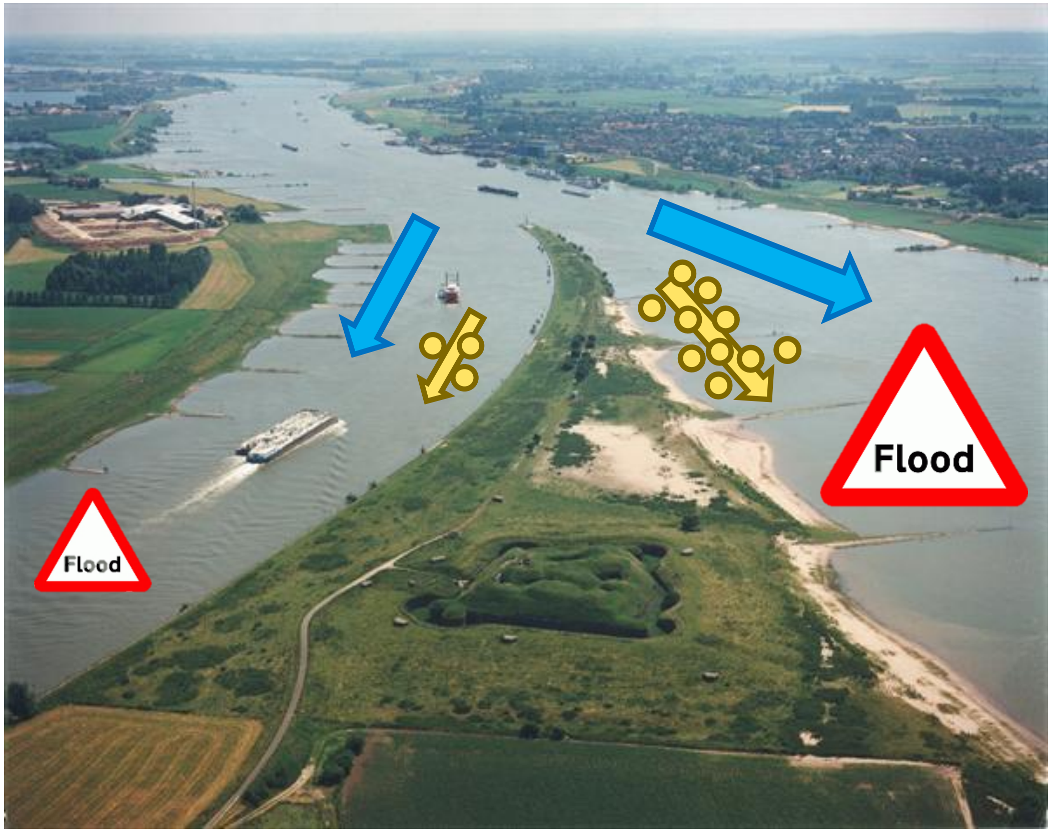
XXXVIII INTERNATIONAL SCHOOL OF HYDRAULICS
21 – 24 MAY, ŁĄCK, POLAND

INTRODUCTION
THE RIVER BIFURCATION



River bifurcations distribute:

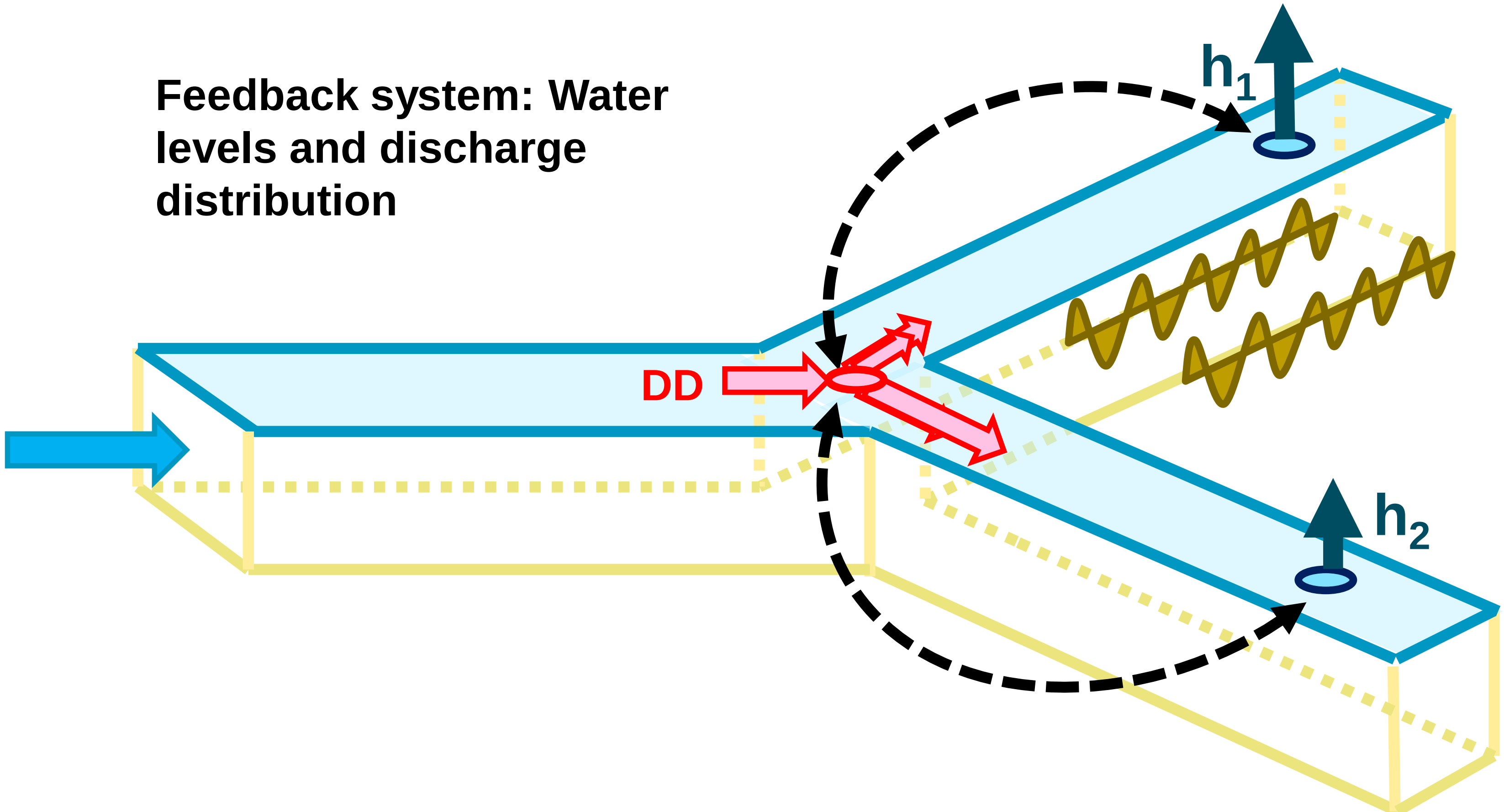
- Discharge
- Sediment
- Flood risk

Picture: Van Houdt, J. (2007). Luchtfoto rivieren splitsing bij Pannerden, Waal en Rijn.

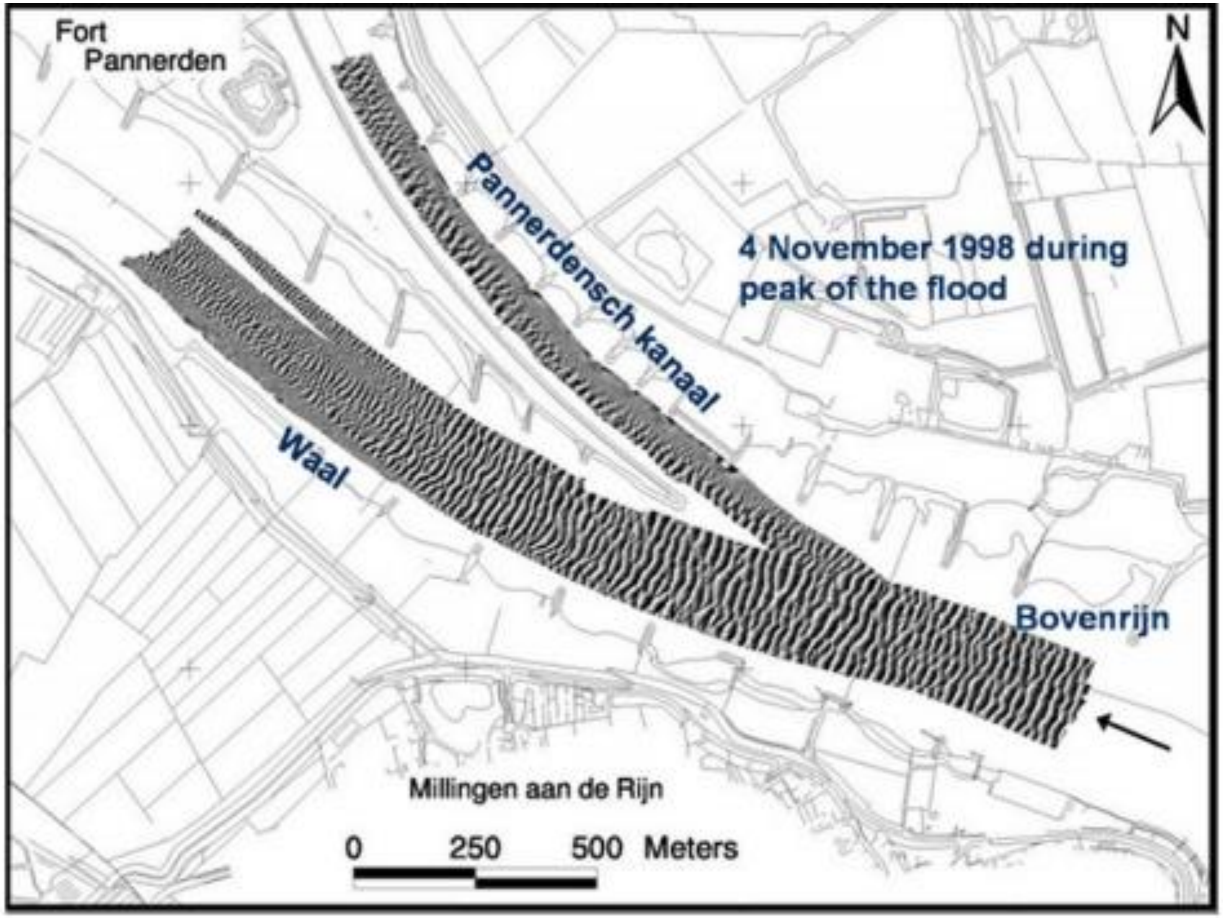
INTRODUCTION

THE RIVER BIFURCATION

Feedback system: Water levels and discharge distribution



INTRODUCTION
RIVER BEDFORMS



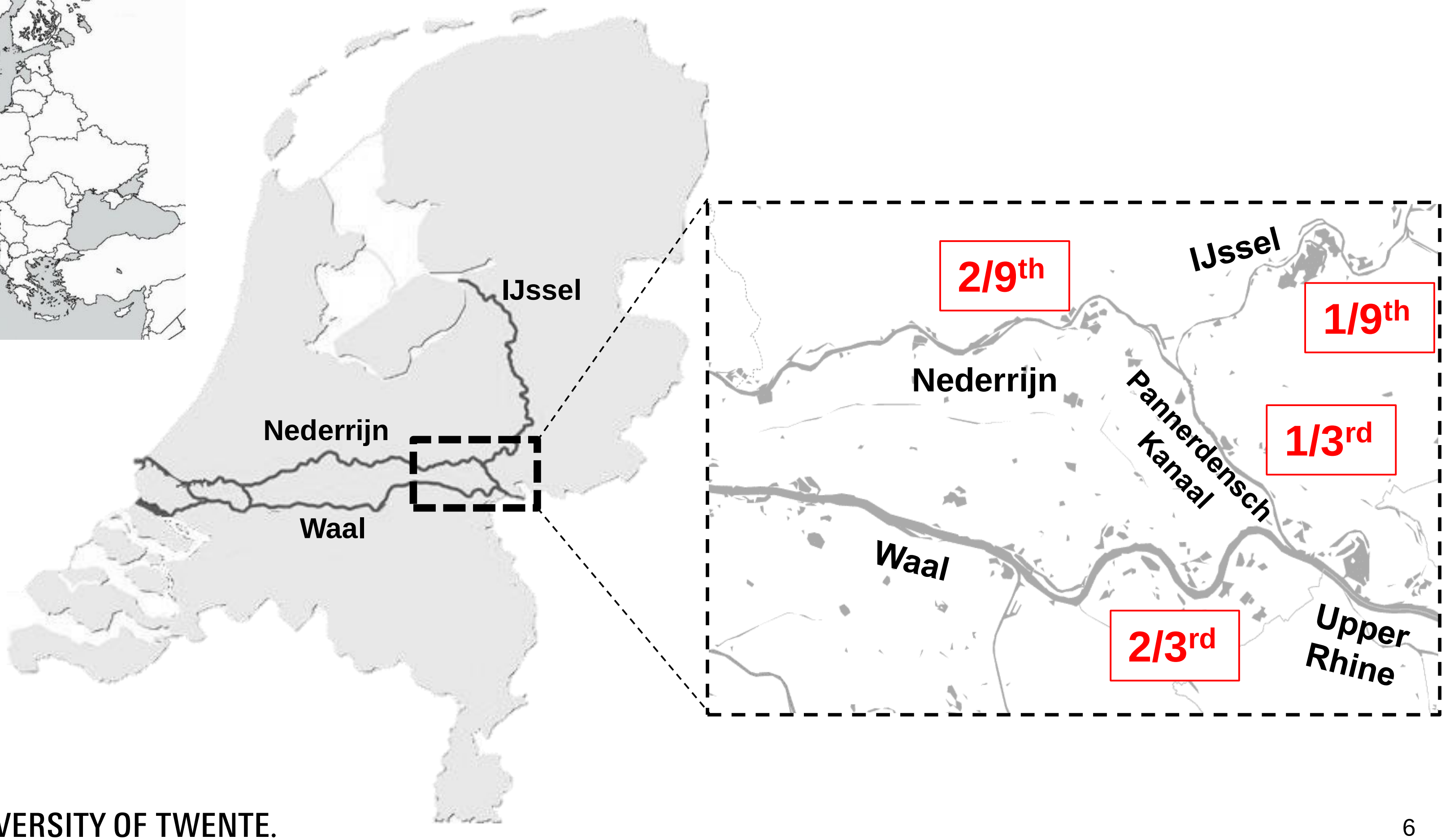
References:
Wilbers, A.W.E. and Ten Brinke, W.B.M. (2003). The response of subaqueous dunes to floods in sand and gravel bed reaches of the Dutch Rhine, Sedimentology, Vol 50-6, pp 1013-1034.

RESEARCH GOAL

To quantify the effect of uncertain river bedform characteristics in a bifurcating river on the water levels throughout the river system

STUDY AREA

DUTCH BIFURCATIONS OF THE RIVER RHINE

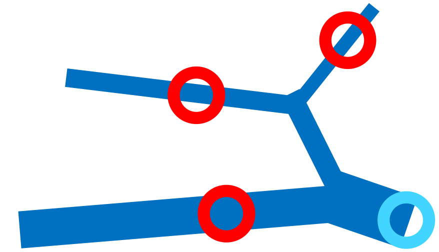


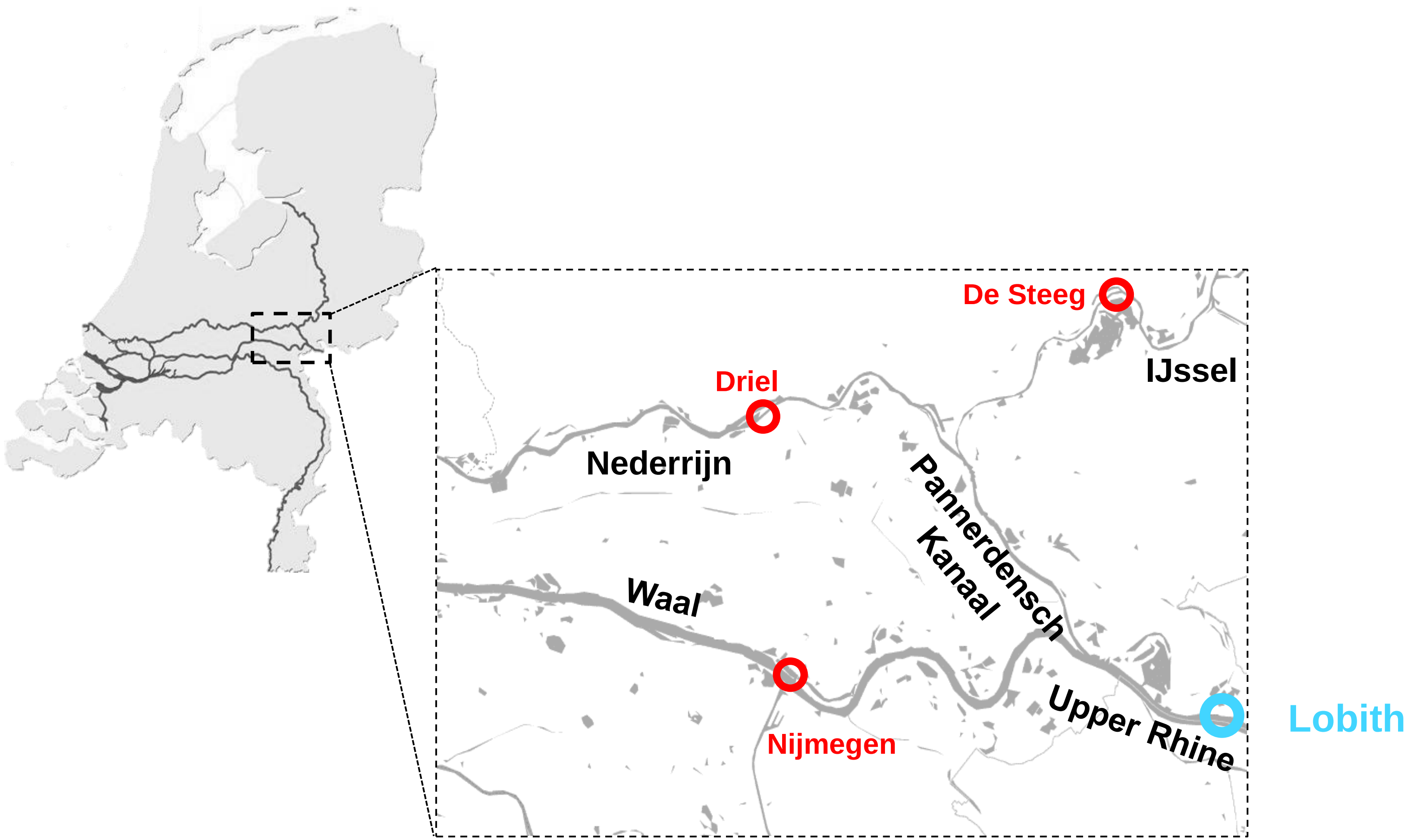
METHODOLOGY

1. Establish roughness scenarios
   - Observations of dune heights and lengths in the branches
   - Predicting roughness values from the observations
   - One higher and one lower estimate of the roughness per branch
   - 16 roughness scenarios: combinations of the higher and lower estimates

2. Determine water levels using 1D hydraulic model
   - Steady upstream discharges of 3,000-18,000 m^3/s
   - Cross-sections with separate main channel and floodplains

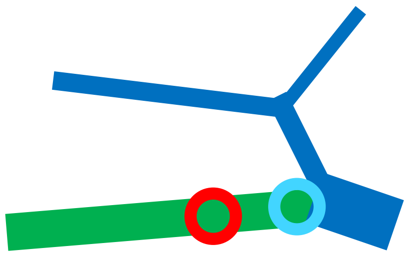
RESULTS
LOCATIONS

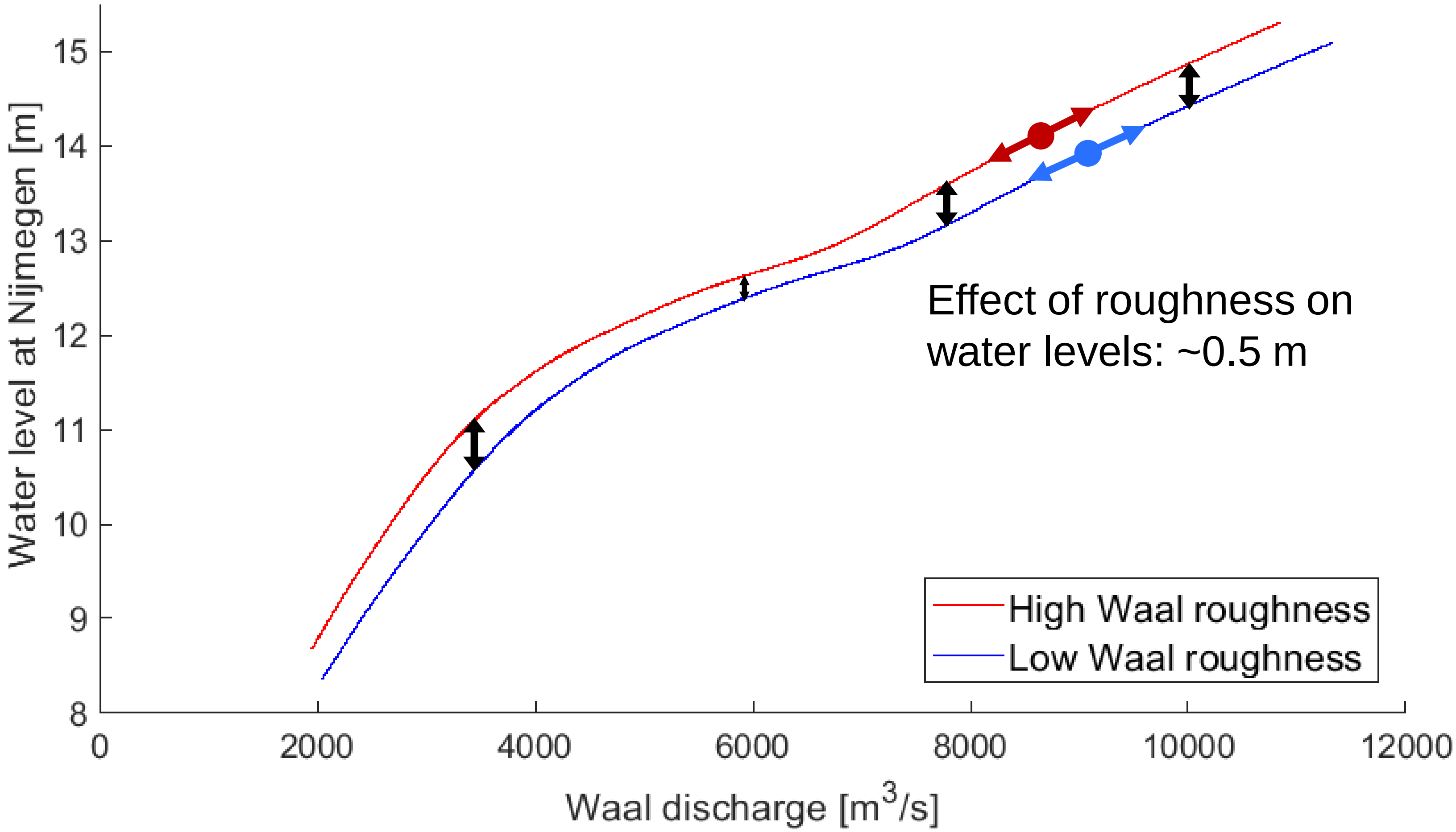




RESULTS

MODELLED WATER LEVELS – NIJMEGEN (WAAL)





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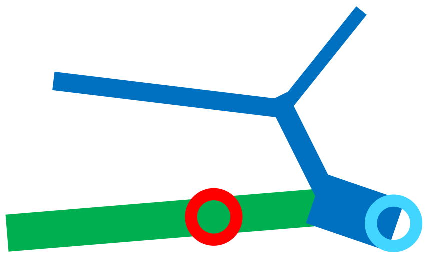
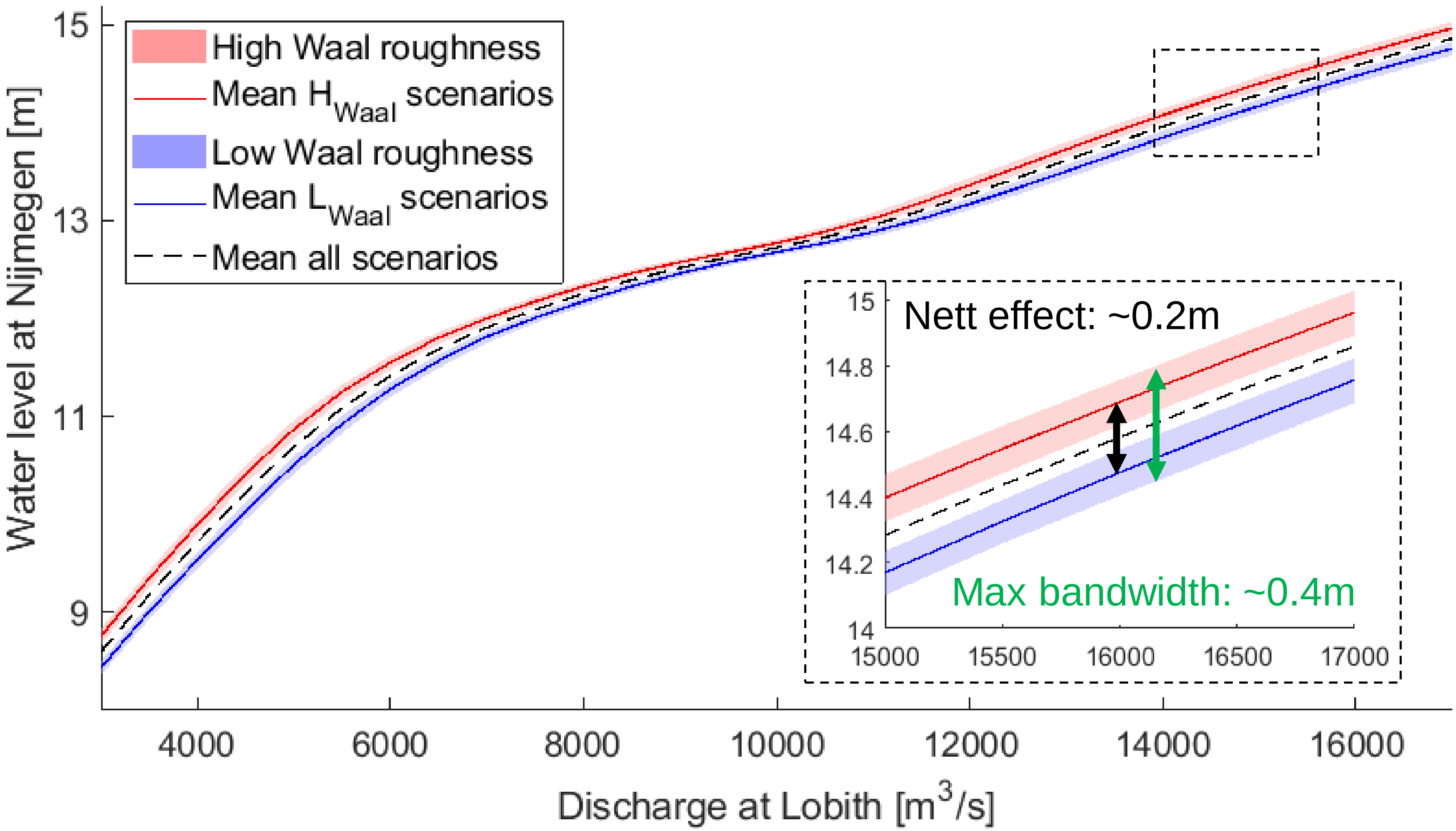
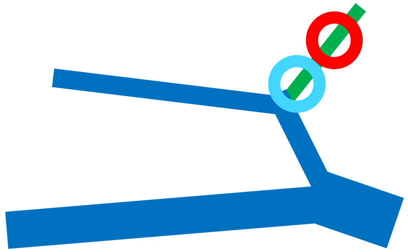
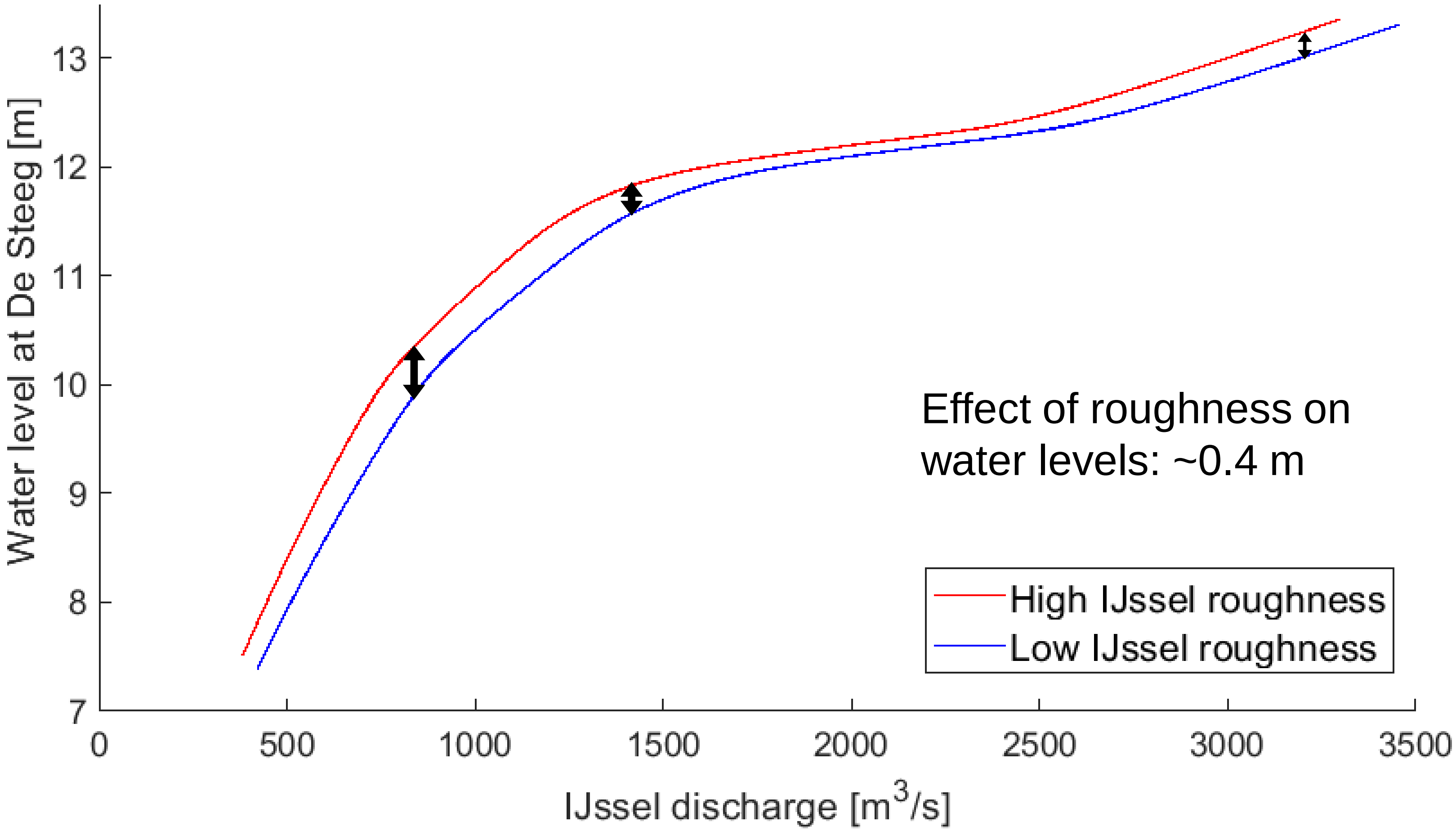




RESULTS

MODELLED WATER LEVELS – DE STEEG (IJSSEL)





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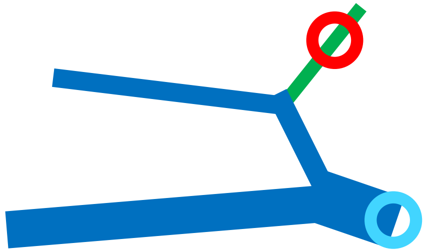
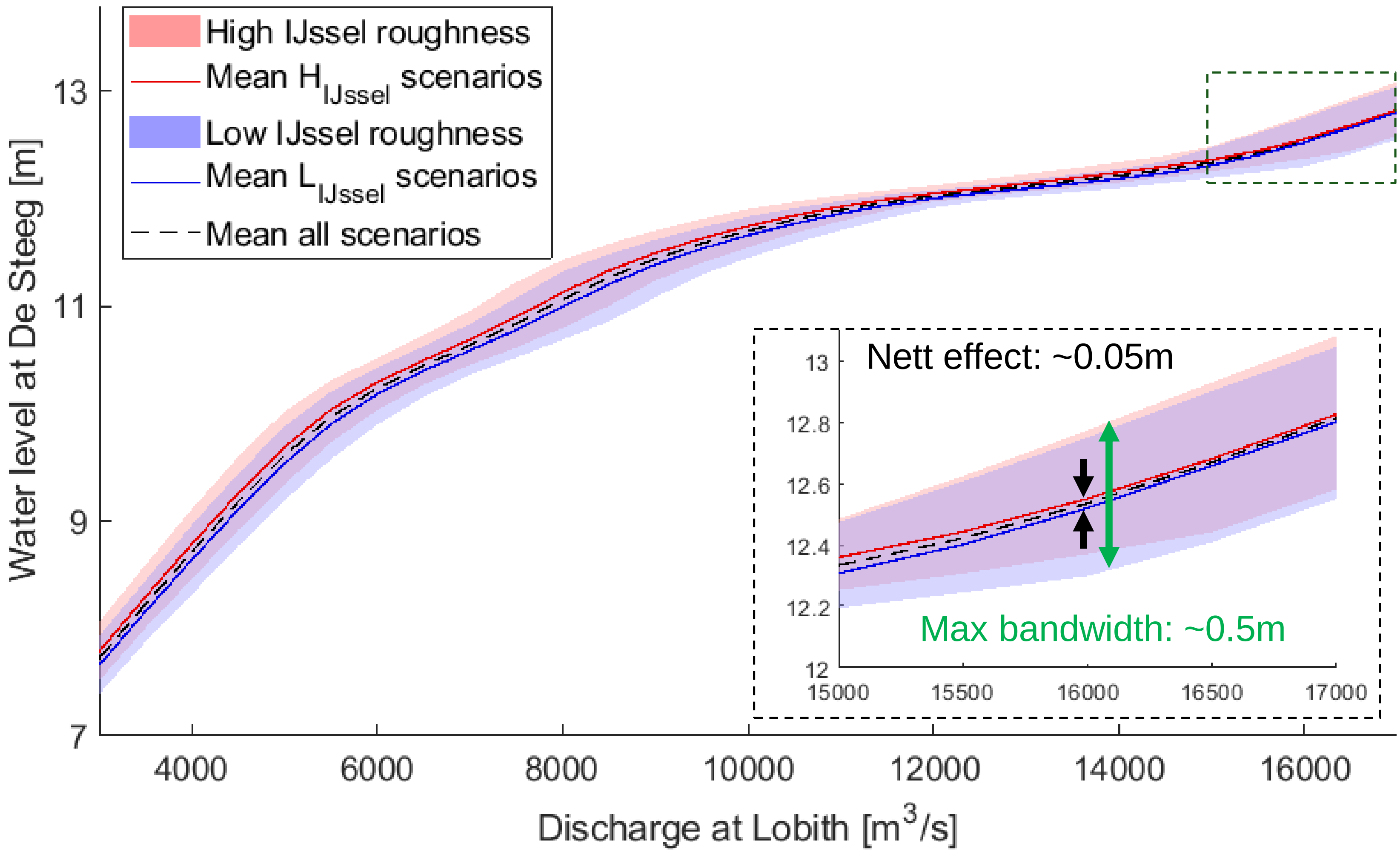
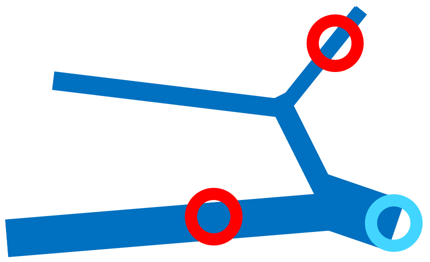




RESULTS

MODELLED WATER LEVELS – OVERVIEW



Discharge at Lobith: 16,000 m^3/s		Average effect on the water level at:		
		Nijmegen (Waal)	Driel (Nederrijn)	De Steeg (IJssel)
Change of roughness of:	Waal	0.21 m	0.15 m	0.25 m
	Pan. Kanaal	0.09 m	− 0.06 m	− 0.09 m
	Nederrijn	0.02 m	0.08 m	0.10 m
	IJssel	0.03 m	0.09 m	0.03 m

Discharge at Lobith: 16,000 m^3/s		Average effect on discharge in branch:		
		Waal	Nederrijn	IJssel
Change of roughness of:	Waal	− 433 m^3/s	163 m^3/s	270 m^3/s
	Pan. Kanaal	161 m^3/s	− 63 m^3/s	− 98 m^3/s
	Nederrijn	44 m^3/s	− 159 m^3/s	115 m^3/s
	IJssel	56 m^3/s	95 m^3/s	− 151 m^3/s

Bandwidth:	**+0.35m**	**+0.38m**	**+0.47m**

Roughness:	**~0.5m**	**~0.4m**	**~0.4 m**

CONCLUSIONS

- The presence of a river bifurcation on average decreases the uncertainties in water levels
- The largest branch, the river Waal, dominates the water levels in all branches
- Regard the river branches as an interconnected system in the assessment of flood risks and the planning of future river engineering works

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