

FHWA, WSDOT, The Netherlands: Collaboration on Infrastructure Resilience and Adaptation

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Services Office, Policy Branch Manager**

NW Climate Conference, Tacoma, WA
October 11, 2017

Collaboration Partners

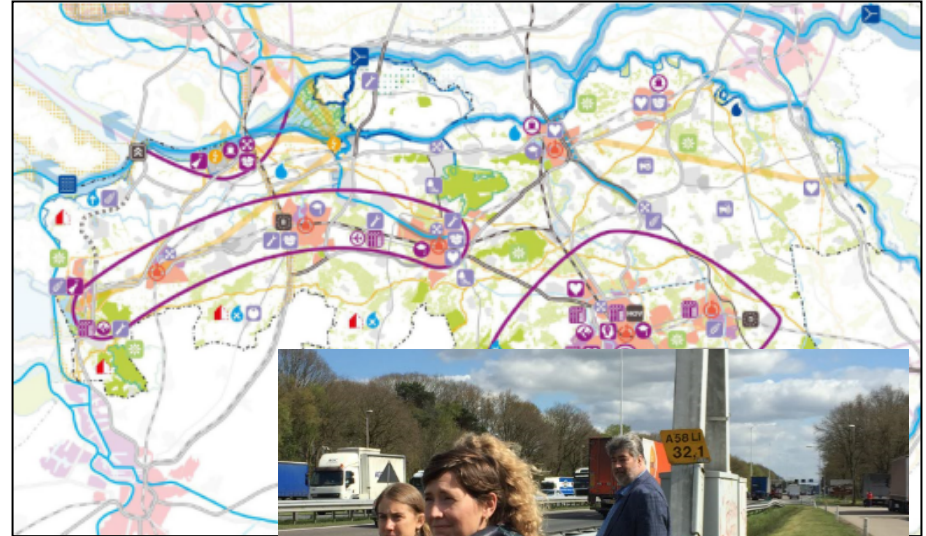
- **Rijkswaterstaat (RWS)** Part of the Dutch Ministry of Infrastructure and Environment
 - Highway network
 - Waterway network
 - Water supply systems
 - 8800 employees, \$4.2 billion Euro annual budget
- **Federal Highway Administration (FHWA)**
 - 3000 employees, \$40 billion annual budget
- **Information Exchanges w/ USDOT**
 - 2014 started to collaborate on climate tools
 - 2016 two project-specific pilots (including WSDOT's SR 167)

Projects on both sides

SR167 Tacoma, Washington State

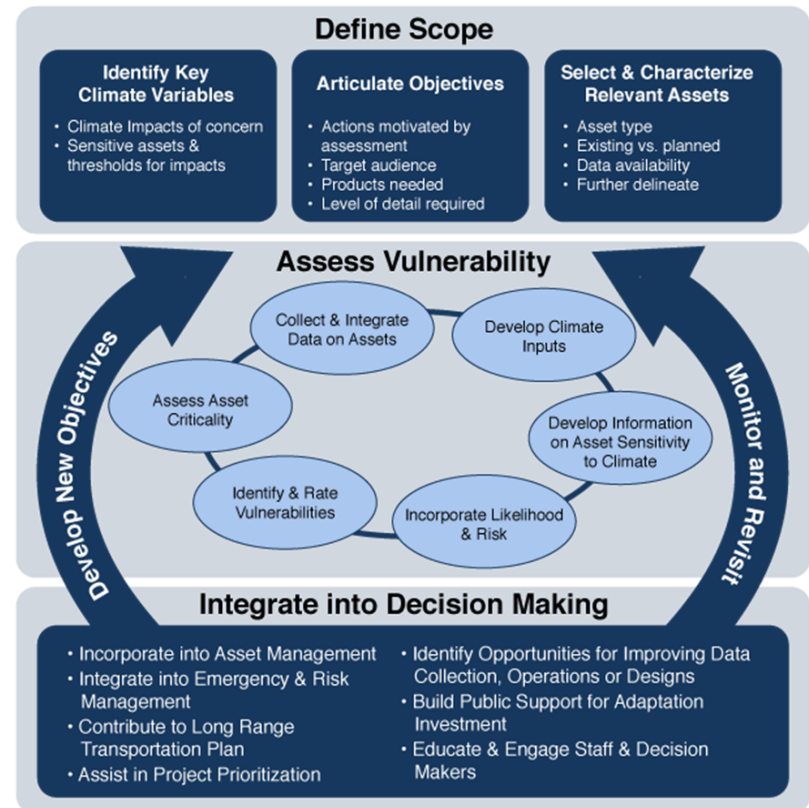
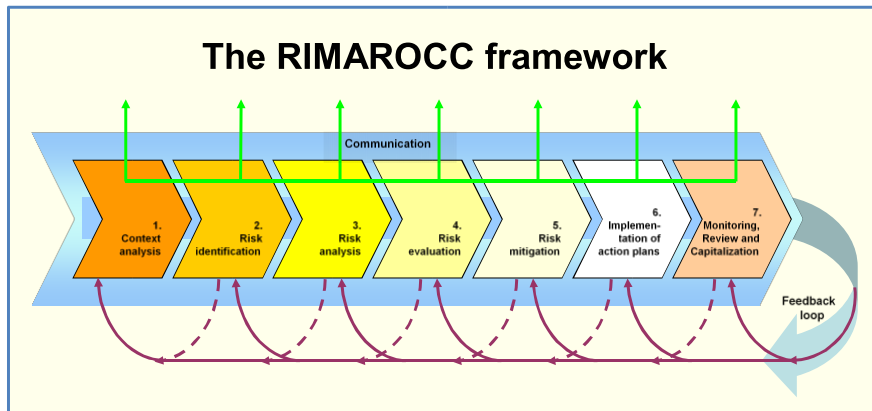


InnovA58, South Netherlands



FHWA/RWS Pilot Project

Compare and Contrast EU's ROADAPT and FHWA's Climate Change and Extreme Weather Vulnerability Assessment Frameworks



• Risk Management for Roads in a Changing Climate (above); FHWA's Framework (right)

- **Test scalable approaches that allow analysis of transportation systems**
- **Two highway projects: SR 167 in Fife, WA
InnovA58 in Holland**

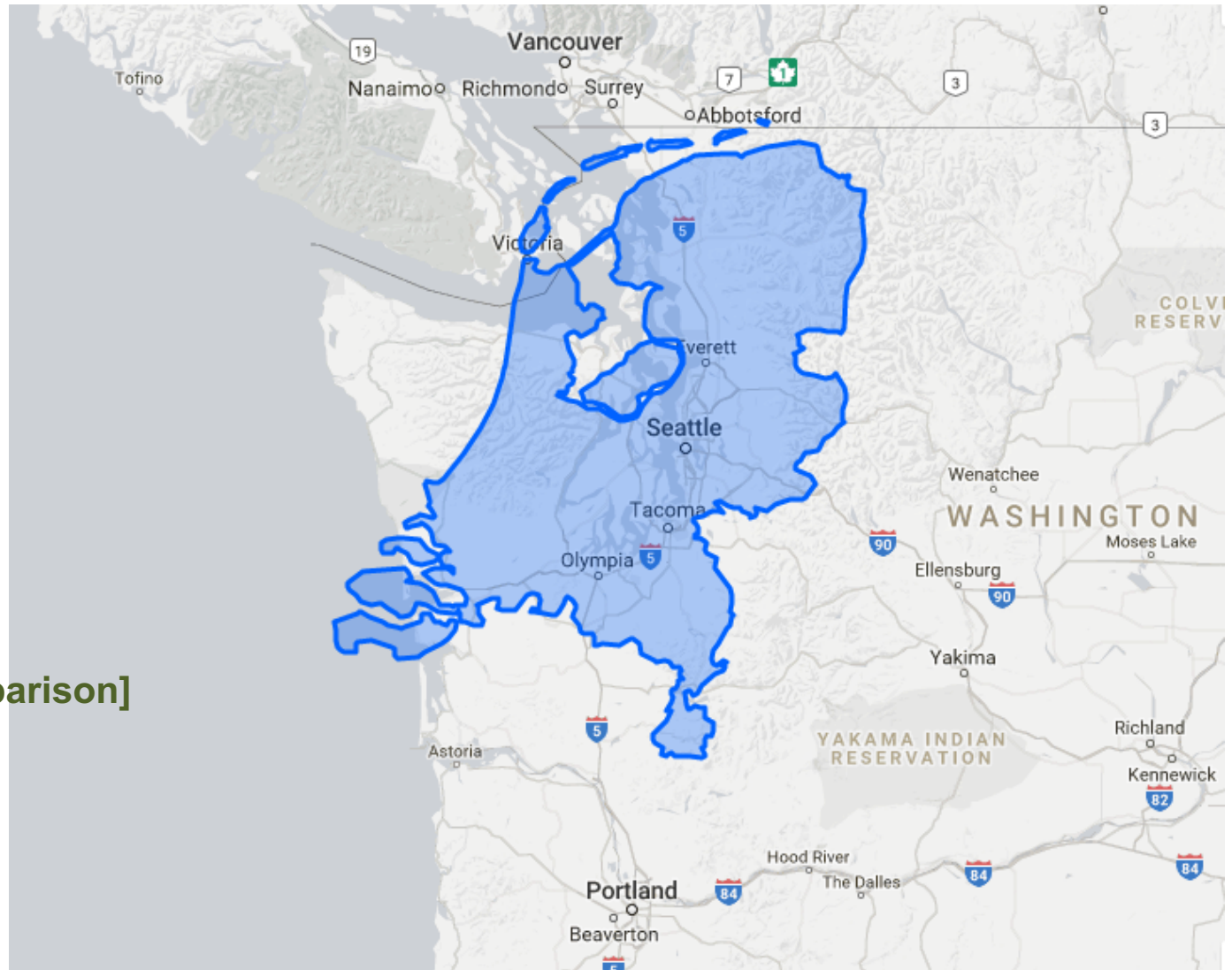
The Netherlands

Population:
17 Million
[7 Million]

Area:
16,000 sq mi
[71,000 sq mi]

Public Roads:
86,000 miles
[82,000 miles]

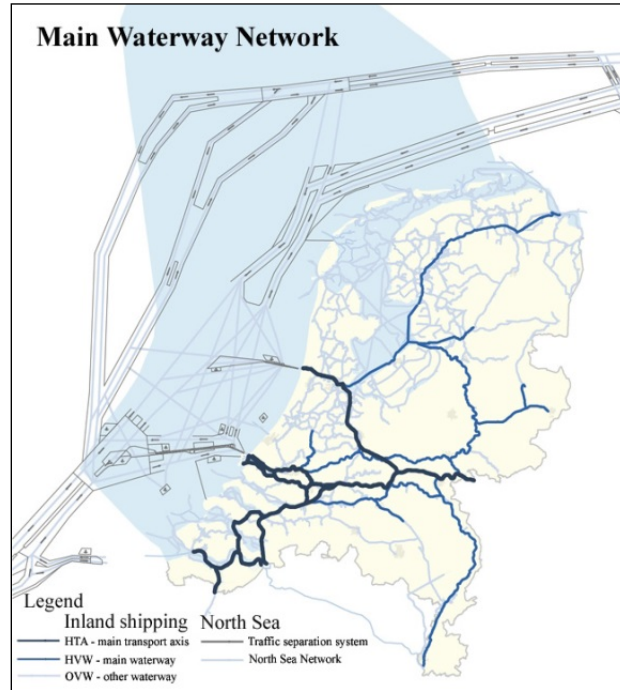
[WA State Comparison]



Rijkswaterstaat (RWS) Dutch Ministry of Infrastructure and Environment



Highway network: 3.102 km



Waterway network: 8.000 km



Flood protection 90.000 km²

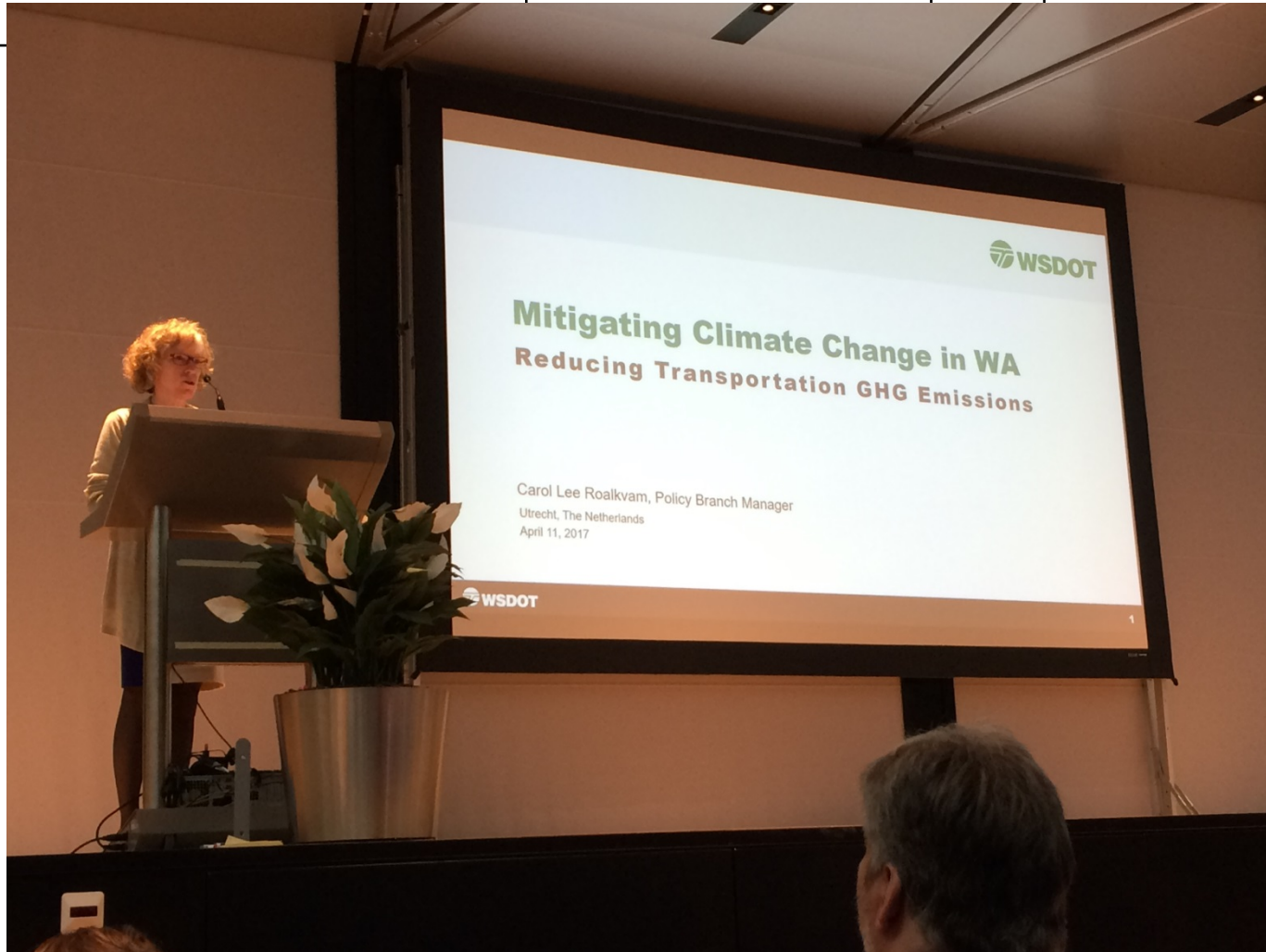


Site Visit April 8-15, 2017



Information Exchange: Formal and informal

Lunch presentation FHWA and WSDOT present on resilience work and work on energy and emissions	Rijkswaterstaat Westraven office Griffioenlaan 2, Utrecht room D1.19	12.00	Tina Hodges (FHWA) Carol Lee Roalkvam (WSDOT)
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Why climate adaptation for highways? Examples from the Netherlands



Key Climate Concerns for the InnovA85 Project

Internal Drainage

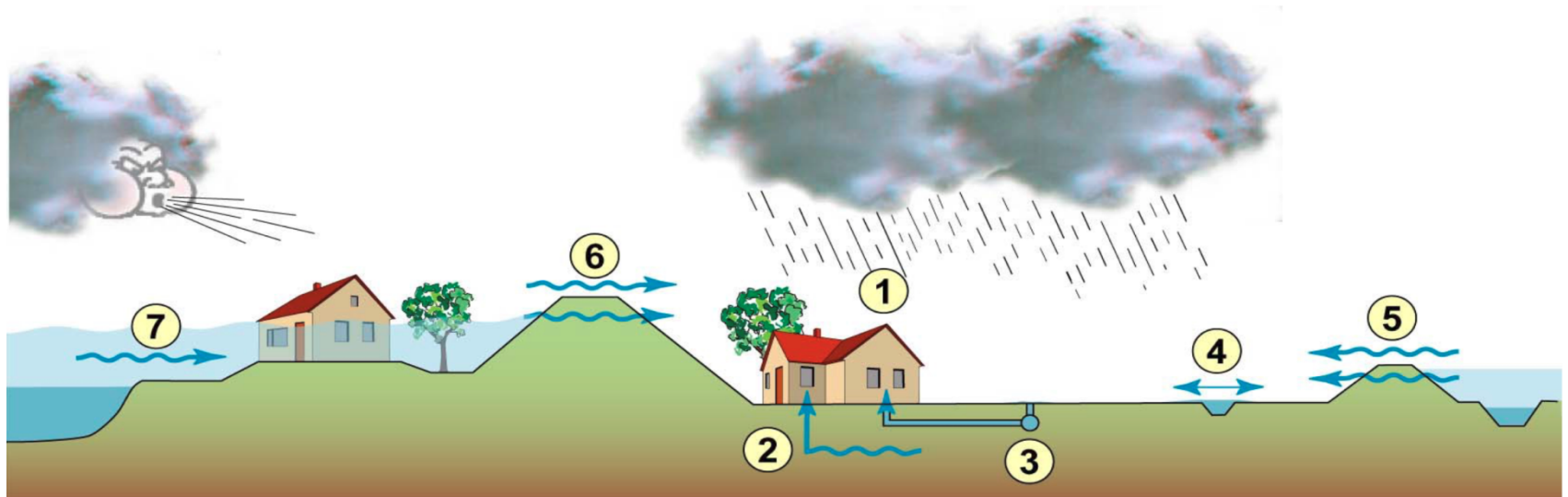
Drought

Pavement Runoff

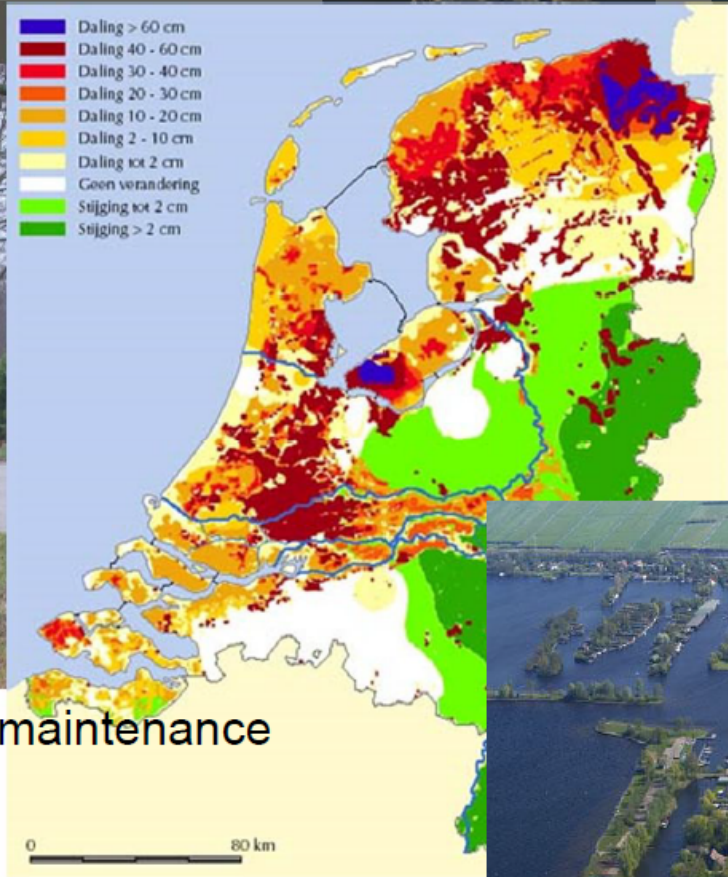


Internal Drainage / Flooding

Highway is vulnerable to inundation from local runoff from more intense or sustained storm events.



Roads and construction in soft soils



- Large uncertainties in construction and maintenance costs

- High costs for infrastructure in subsiding area's (€ 100 per year extra/per household)

- Geotechnical failures cost around 50 M€ per year for the Dutch Ministry of Infrastructure and the Environment (I&M)

Rainfall Intensity, Duration, and Frequency - IDF Curves

KNMI - Koninklijk Nederlands Meteorologisch Instituut (National Weather Service)

- State selected emission scenarios and global climate models
- RWS developed new IDF curves that are in place for engineers to use for design today
- 30 to 40% by 2050.. >50% increase in intensity by 2100

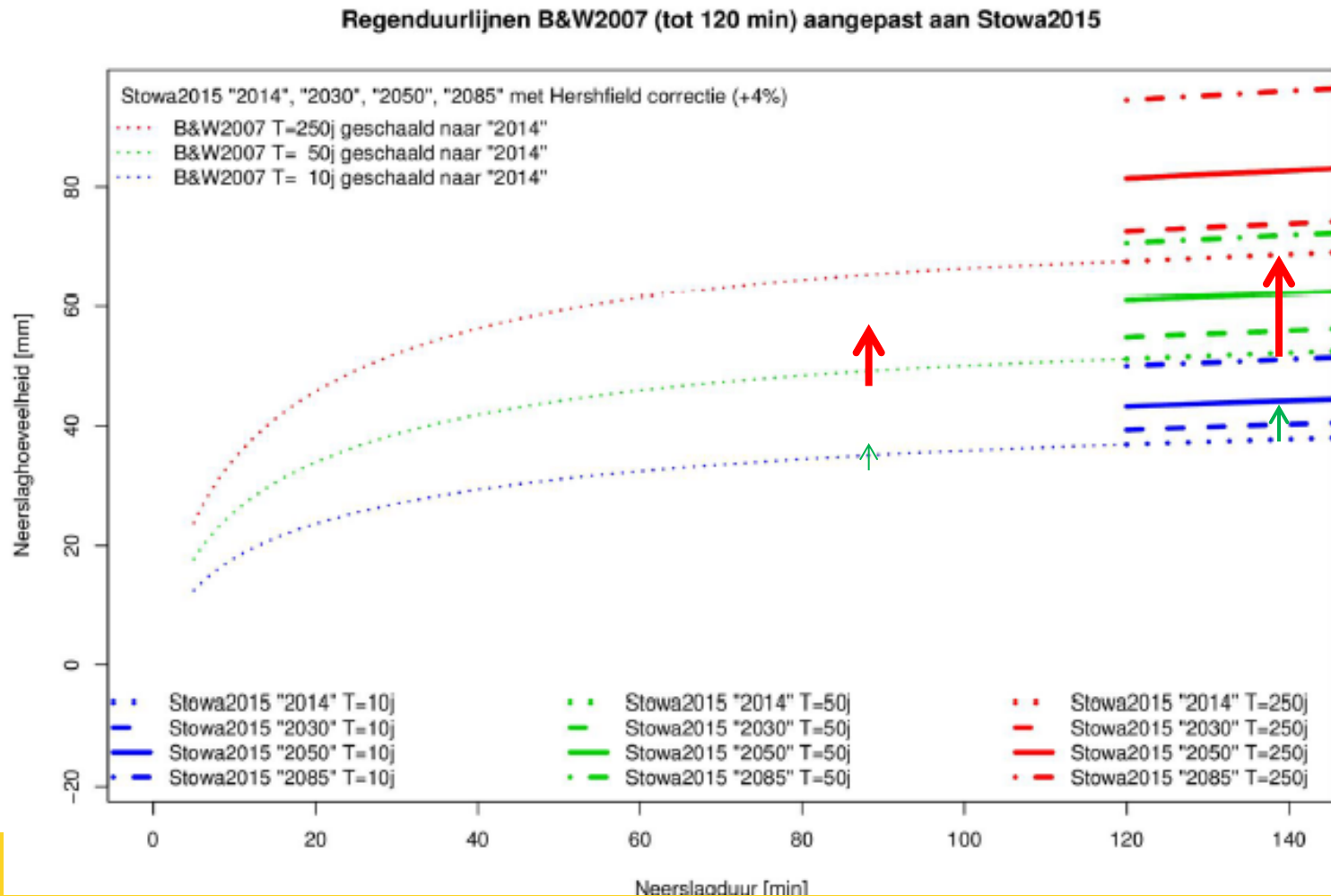
In Washington we have not yet downscaled daily climate models to create IDF curves for the future.

- Relying on academic institutions UW, WSU, etc.
- No State standard
- FHWA suggests RCP 6.5 and 8.0 in HEC-27
- Ultimately it is left up to the project engineer to decide what to do

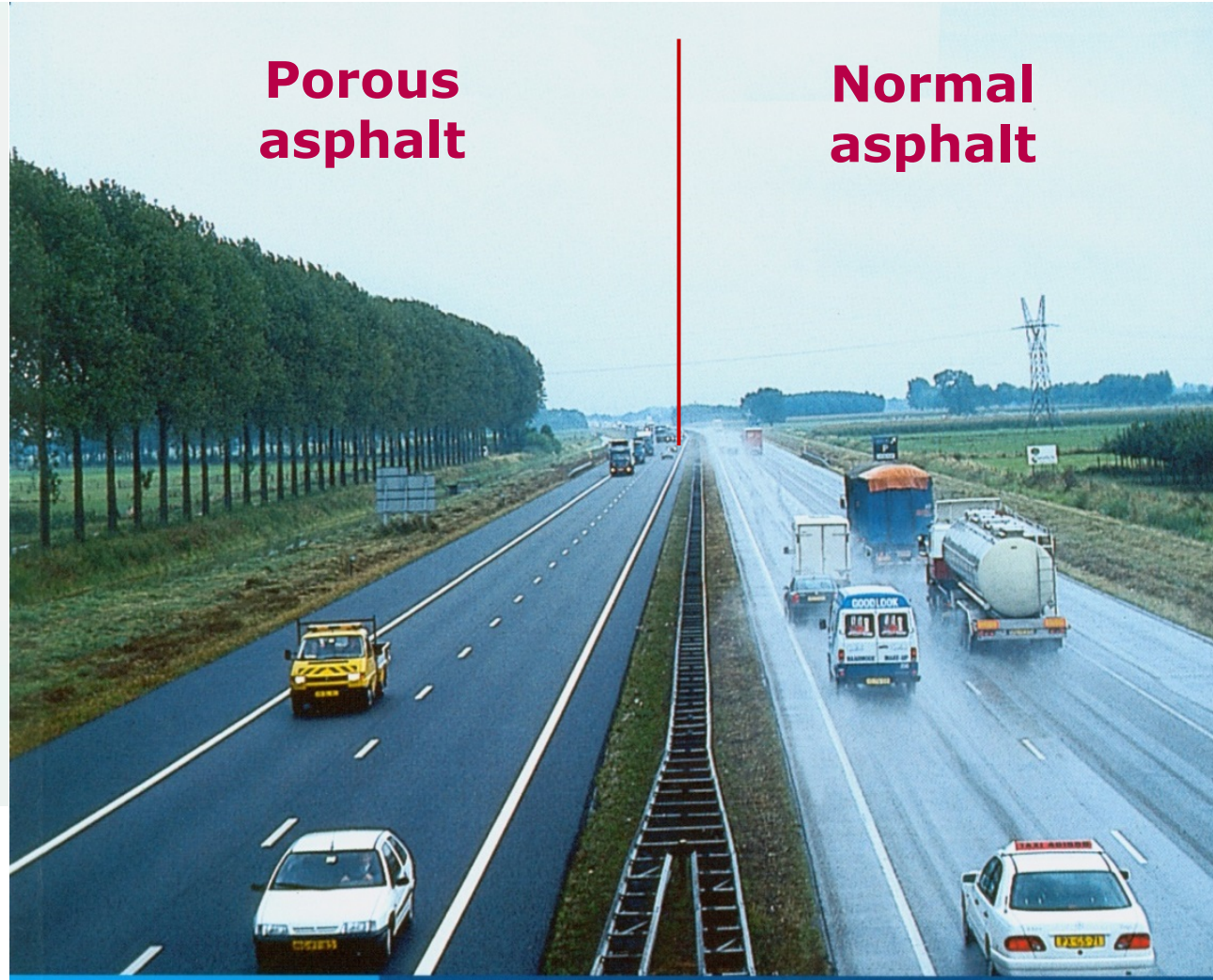
Implications road design



Current situation: STOWA assignment -> KNMI, HKV (now – Oct 2017):
Implication for rain duration curves...



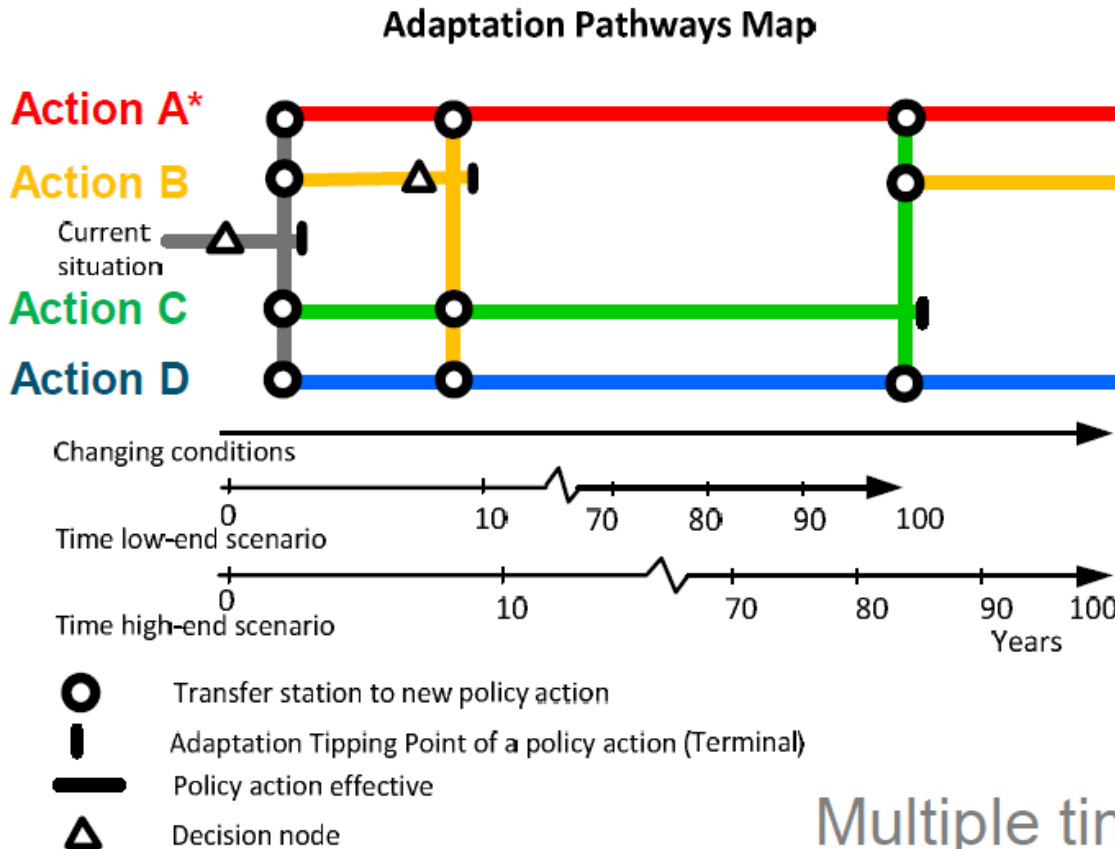
Netherlands Highways Porous Asphalt





Deltares, Delft
research facilities, wave flumes

An adaptation pathways map shows **different possible sequences of investment decisions**. A scorecard helps to evaluate the pathways and potential decisions.



Costs and benefits of pathways

Pathway	Time horizon 20 years		
	Costs	Benefits	Co-benefits
1	+++	+	0
2	++++	0	0
3	+++	0	0
4	+++	0	0
5	0	0	-
6	++++	0	-
7	+++	0	-
8	+	+	---
9	++	+	---

Pathways that are not necessary in low-end scenario

Multiple time-axes show uncertainty in moment of ATP

* single action or portfolio of actions

Delfland Coast Sand Engine

Nature-based solutions / Building with Nature

www.ecoshape.nl



Flood Disaster - “Watersnoodramp”

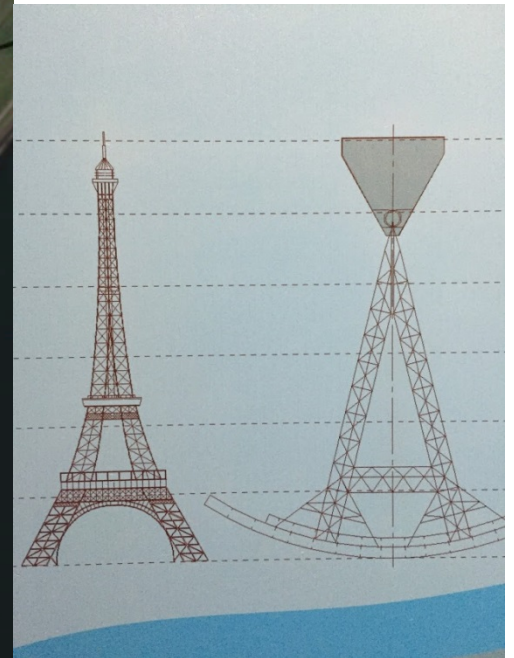


- 1,836 deaths
- 72,000 evacuated
- 47,300 buildings severely damaged
- 200,000 farm animals drowned

WATER YOU THINKING?



Coastal Protection – Storm Surge Barrier



Delta Works

Designed to protect the major estuaries:

- Rhine
- Meuse
- Scheldt

Started in 1958, the last stage completed in 1998.



Coastal Protection Gates



WSDOT Climate Pilot Contacts

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