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

Carol Lee Roalkvam – WSDOT Environmental Services Office, Policy Branch Manager

SCOE Annual Meeting, Des Moines, Iowa
July 17, 2017
Collaboration Partners

• **Rijkswaterstaat (RWS)** Part of the Dutch Ministry of Infrastructure and Environment
  – Highway network
  – Waterway network
  – Water supply systems
  – 8,800 employees, $4.2 billion Euro annual budget

• **Federal Highway Administration (FHWA)**
  – 3,000 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

Utrecht
Information Exchange: Formal and informal

<table>
<thead>
<tr>
<th>Lunch presentation</th>
<th>Rijkswaterstaat Westraven office</th>
<th>12.00</th>
<th>Tina Hodges (FHWA) Carol Lee Roalkvam (WSDOT)</th>
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<tbody>
<tr>
<td>FHWA and WSDOT present on resilience work and work on energy and emissions</td>
<td>Griffioenlaan 2, Utrecht</td>
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<td>Griffioenlaan 2, Utrecht</td>
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Mitigating Climate Change in WA
Reducing Transportation GHG Emissions

Carol Lee Roalkvam, Policy Branch Manager
Utrecht, The Netherlands
April 11, 2017
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)

13 April 2017  
Source: Deltares
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

Porous asphalt

Normal 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.

**Adaptation Pathways Map**

- **Action A***
- **Action B**
- **Action C**
- **Action D**

**Changing conditions**

- Current situation

**Time low-end scenario**

- 0
- 10
- 70
- 80
- 90
- 100

**Time high-end scenario**

- 0
- 10
- 70
- 80
- 90
- 100

- Transfer station to new policy action
- Adaptation Tipping Point of a policy action (Terminal)
- Policy action effective
- Decision node

**Costs and benefits of pathways**

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<th>Pathway</th>
<th>Costs</th>
<th>Benefits</th>
<th>Co-benefits</th>
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Pathways that are not necessary in low-end scenario

* single action or portfolio of actions

**Multiple time-axes show uncertainty in moment of ATP**
Delfland Coast Sand Engine

Nature-based solutions / Building with Nature

www.ecoshape.nl

July 2011

April 14, 2017
Flood Disaster - “Watersnoodramp”

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

Policy:
Carol Lee Roalkvam
WSDOT Environmental Policy Branch Manager
RoalkvC@wsdot.wa.gov
360.705.7126

Technical:
Simon Page
WSDOT Hydraulics Section Hydrology Program
PageSi@wsdot.wa.gov
360.705.7472