Norwegian Public Roads Administration

Norwegian Roads Adapting to Climate Change

- Roads in Norway in a challenging climate
- Investigations
- Adaptation measures
- ...

What was important for the work?

Do we have a good basis for adaptation?

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Oslo, Norway
Annual precipitation (mm) 1971–2000

3000 – 4000 mm

500 – 1500 mm

Map shows normal annual precipitation (in mm) for normal period 1971-2000.

Data owner: Norwegian Water Resources and Energy Directorate

16.9.2015.

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A warmer and wetter climate

Challenges for the road network
Higher risk of flood and erosion, insufficient drainage capacity
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Wave erosion, flooding from sea, storm surge – important for coastal roads and elevation of sub-sea tunnels.
Higher risk of landslides and avalanches, occurring new places and more frequently.
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Foto: Ole Andre Helgaas
Debris flows & slush avalanches
Operation problems due to heavy snowfall.

Photo: Hege Lysholm

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NPRA addressing climate change
R&D program «Climate and Transport»

Aim: investigate all effects of climate change on roads & propose remedial measures.

Budget € 2,2 mill over four years
NPRA addressing climate change

R&D program «Natural Hazards – Infrastructure, Floods andSlides»

Collaboration between:
- NPRA
- Norwegian National Rail Administration
- Norwegian Water Resources and Energy Directorate

Budget € 4.5 mill over four years

mapping – risk and vulnerability –
- landslides & avalanches – flooding – quick clay –
- protections measures – preparedness –
Climate change
National framework for adaptation
National framework for adaptation
Climate projections

"Climate in Norway 2100"
Norwegian Climate Centre, 2009

Update according to IPCC 5th A.R.
to be launched 9/22/2015
National framework for adaptation
Vulnerability analysis in Norway 2010

NOU 2010:10
Official Norwegian Report
«Adapting to a changing climate”

The adaptive capacity of the transport sector was found to be satisfactory, based on the following criteria:
• Organization
• Resources
• Knowledge base for adaptation,
• Priorities
Adaptation measures

Implemented, planned and work in progress
Norwegian Public Roads Administration

Manuals for design and practice

- based on standards
- addition explanations, requirements, guidelines for roads and road structures.
- planning, design, operation, maintenance and management of the road network

Climate change
Requires an adaptation of all manuals that are affected by climate change.
Adaptation measures

Four main groups of adaptation measures

- New roads: planning, design, construction
- Existing road network: operation, maintenance, management
- Preparedness plans
- Improving the knowledge base for adaptation
Alignment:

- climate conditions belong to **premises for planning**
- **200-year** flood level as basis for design of road elevation.
- additional safety margin shall involve hydrology expertise
- sea level rise and storm surge levels must be taken into account
New roads – Avoiding vulnerability
Planning and design

● whenever possible, the road should be placed in areas less prone to landslide and flood hazard, or where this hazard is easier to handle.

● special attention should be given to crossing waterways.

● comprehensive drainage plans – that cover a larger area (retention ponds, terrain ditches
New roads – Avoiding vulnerability

Ensuring sufficient capacity

Robustness or “climate factor” introduced in the calculation of capacity

\[ Q = C \times i \times A \times K_f \]

\( K_f > 1 \). The value is chosen for each case, depending i.a. on the quality of weather data and climate projection
Prioritizing maintenance

- Considering impacts of climate change should be a part of all work processes.
- Adaptation measures should preferably be carried out as part of scheduled maintenance.
Inventories of vulnerable assets

- NPRA carries out a large scale surveys from the aspect of redundancy
- Climate change is introduced in the survey
Existing roads – Mainstreaming adaptation

Management plans for river catchments

Cooperation between owners of properties and infrastructure is important for adaptation to climate change
Measures for improving preparedness

Web portal xgeo.no

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Statens vegvesen
Norwegian Public Roads Administration

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Measures for improving preparedness

Preparedness plans

- Snow avalanche path
- Slush flow incidents
- Roadblock
- Avalanche mounds
- Weather station
- Emergency ferry
Measures for improving preparedness
Registration of natural hazards

Web and smartphone application

- Driving conditions
- Crew list
- Natural hazard
- Operation area

Area evaluated

- Snow avalanche hazard
- Landslide hazard
- Other natural hazards
- Concern for roads

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Improving the knowledge base

Climate – current and future

- **Improve monitoring**: rain intensity, runoff water, wind, flood values etc.
- Better **maps** and GIS databases
- Better documentation of events
- Functional databanks for landslide data
- Self–monitoring structures etc.
Collaboration and coordination

- The ministry level: coordinated budgets for actions regarding climate change
- Cooperation between road engineers, hydrologists, meteorologists, geologist …
- Cooperation between state and municipality level
Conclusions

What was important for the work?

Do we have a good basis for adaptation?

- Thinking early – including aspects of climate change in planning
- Mainstreaming adaptation
- Cooperation is a condition for adaptation!
  Climate projections, climate data, design basis
Thank you!

www.vegvesen.no/klimaogtransport
www.naturfare.no

Foto: Arne Veum