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Roads on Peat

Ron Munro, ROADEX IV Project Manager

ROADEX final seminar
Inverness, 21 May 2012

Roads on Peat - outline

- ROADEX and peat
- Environmental considerations
- Engineering & risk management
- Construction methods
- Maintenance of roads on peat
- Examples of good practice
- Conclusions

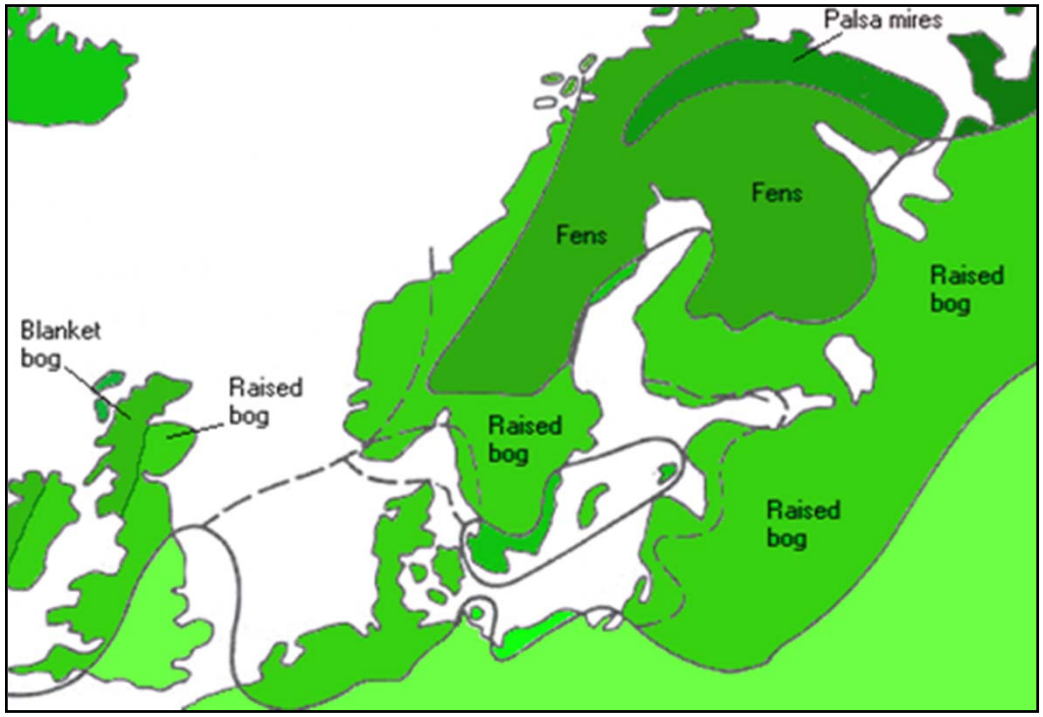
Natural peatland

Road improvement

Road widening

Roads on Peat:
Peat across the Northern Periphery

- Palsa mires
- Fens
- Raised bogs
- Blanket Bogs



Mire zones across northern Europe, Succow & Jeschte 1990

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ROADEX Roads on Peat

4 reports on the website:

- ROADEX II Report, 2005
  ”*Dealing with Bearing Capacity Problems on Low Volume Roads Constructed on Peat*”
- ROADEX II Guidelines, 2005
  ”*Guidelines for the Management of Peat Slips on the Construction of Low Volume/Low Cost Roads over Peat*”
- ROADEX III Executive Summary, 2006
  “*Managing Peat Related Problems on Low Volume Roads*”
- FCE/SNH Report, 2010
  “Floating Roads on Peat”

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Roads on Peat - eLearning

Contents:

- Peat
- Behaviour of peat
- Environmental considerations
- Geotechnical risk management
- Engineering considerations
- Investigations & surveys
- Construction of roads on peat
- Maintenance of roads on peat
- Monitoring
- Records

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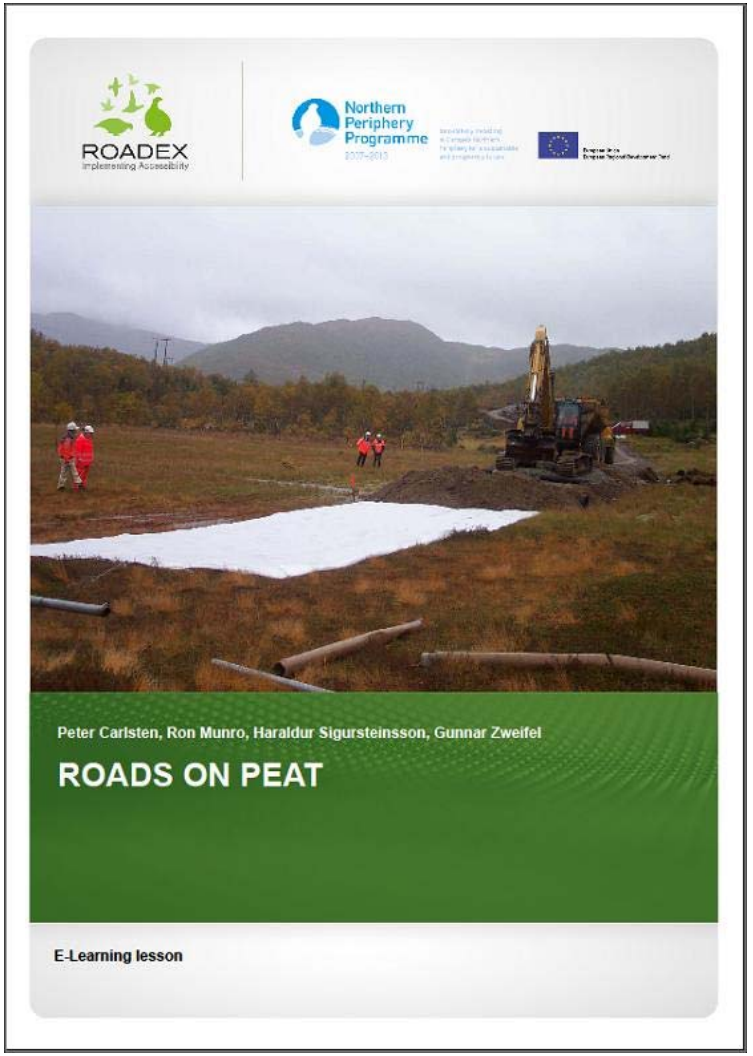
Roads on Peat - eLearning

Task work group:

- Haraldur Sigursteinsson, ICERA
- Gunnar Zweifel, Trafikverket
- Peter Carlsten, Trafikverket
- Ron Munro, MCL



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What can go wrong:

Peatslide, Ireland, 2009

Verge loaded with 1m of excavated peat

What can go wrong – the movie:

Peatslide, moving on a slope of 2%

What can go wrong:

Gjábakkavegur peatslide, Iceland, October 2009

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Environmental considerations

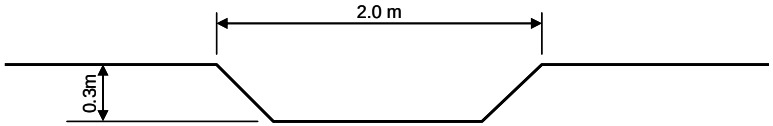
- Usually a protected area/ecology/habitat
- Sensitive to changes in hydrology
- Disturbance
- Pollution
- Construction
- Drainage

BBC Scotland

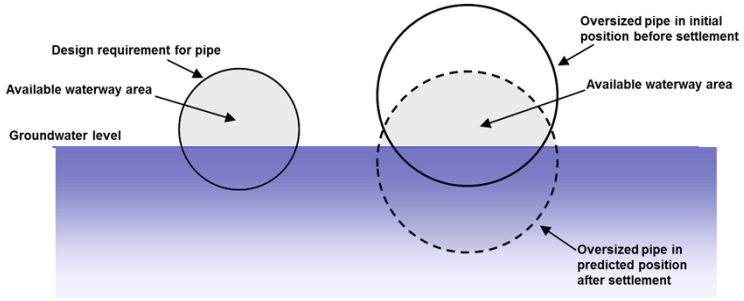
Roads on peat considerations

Drainage/hydrology:

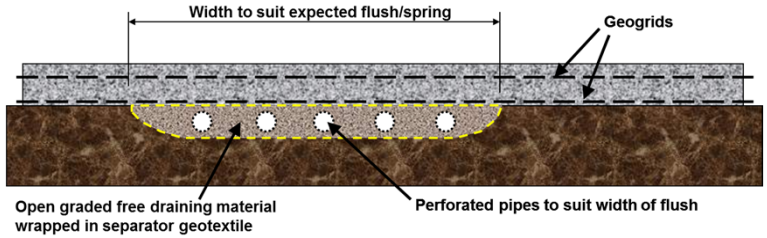
Floating road – no ditches



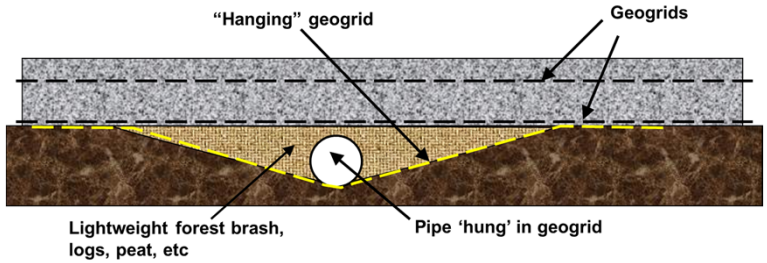
Shallow ditches rather than deep ditches



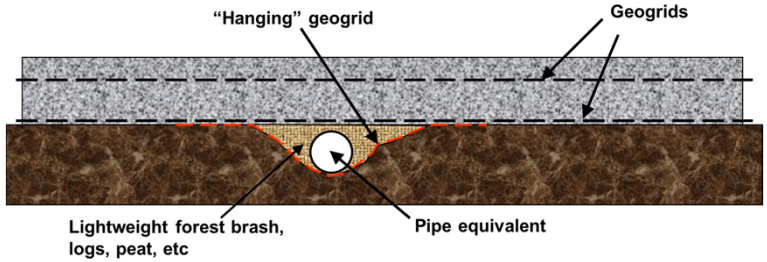
Oversizing culverts to permit settlement



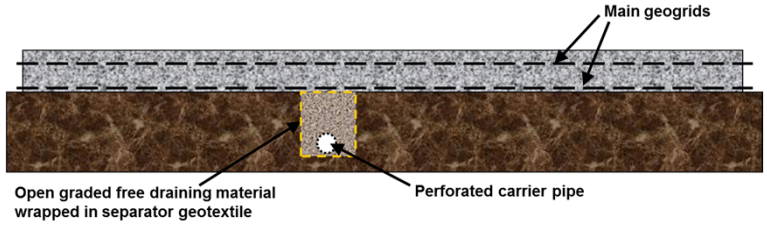
Dealing with surface flows of water



Hanging culvert in a geogrid



Hanging culvert in a geogrid



Stone filled ditch wrapped in geotextile

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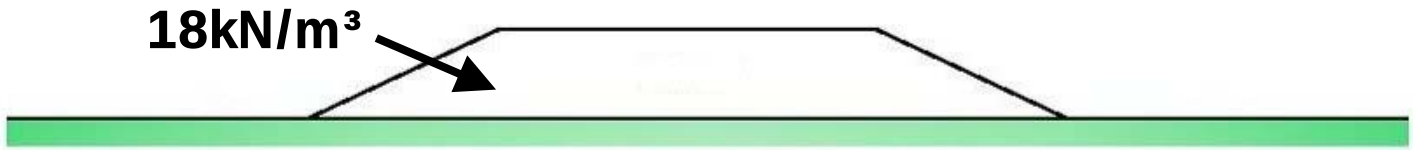
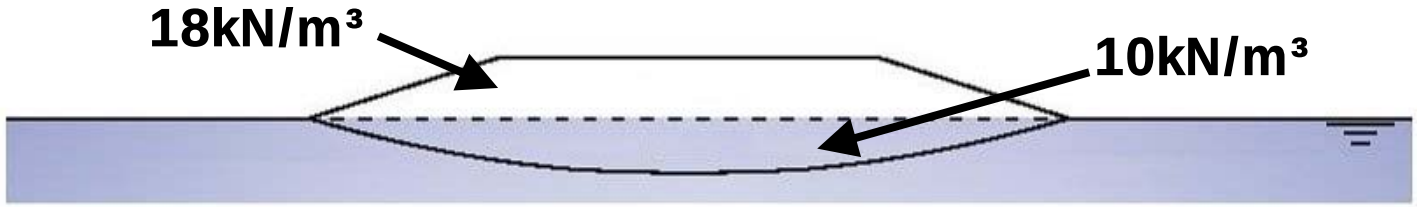
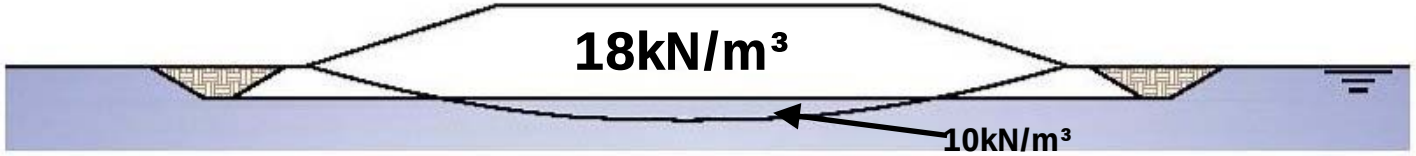
Drainage/hydrology – existing roads
Buoyancy effects on peat



Road on a sound foundation



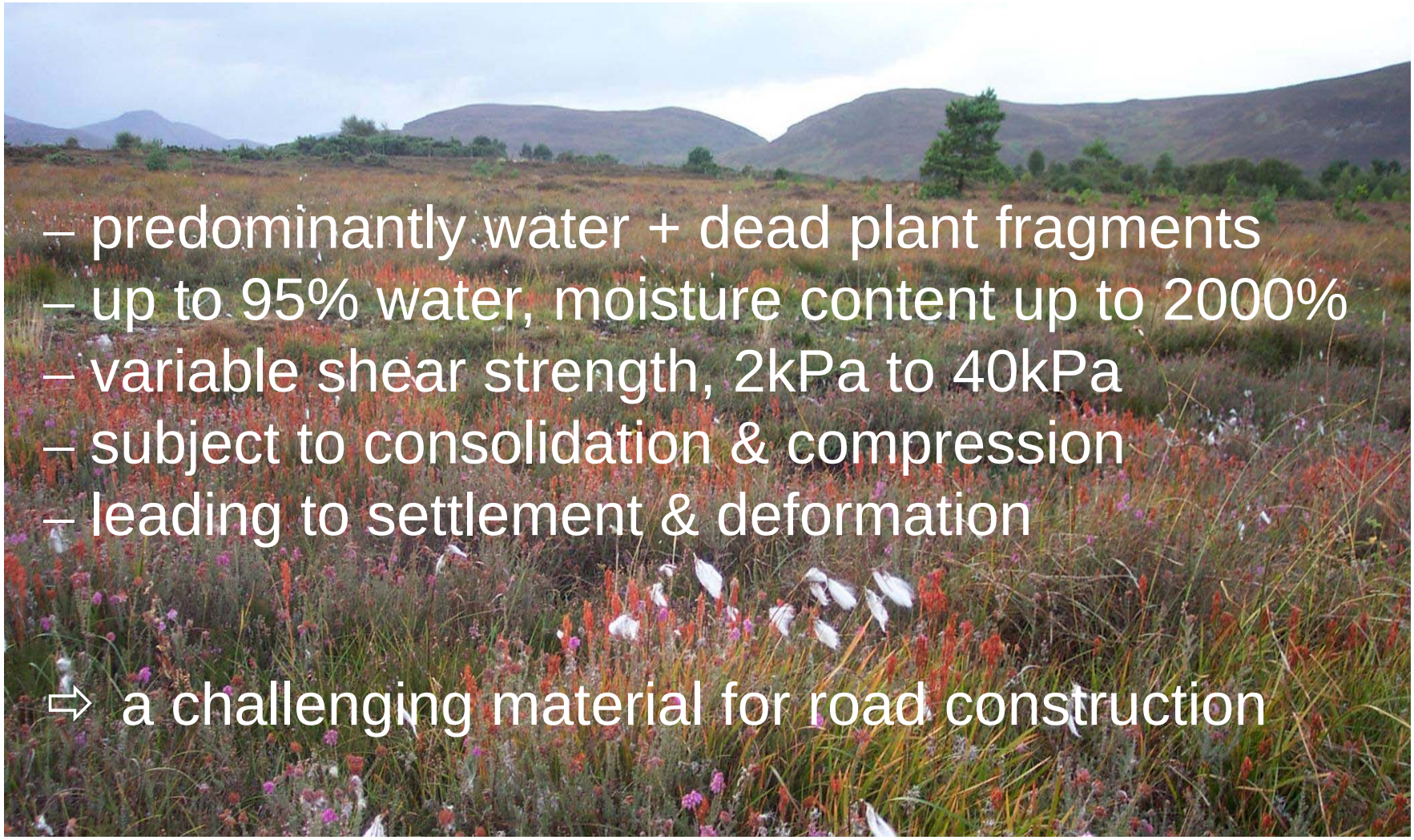
Floating road on peat



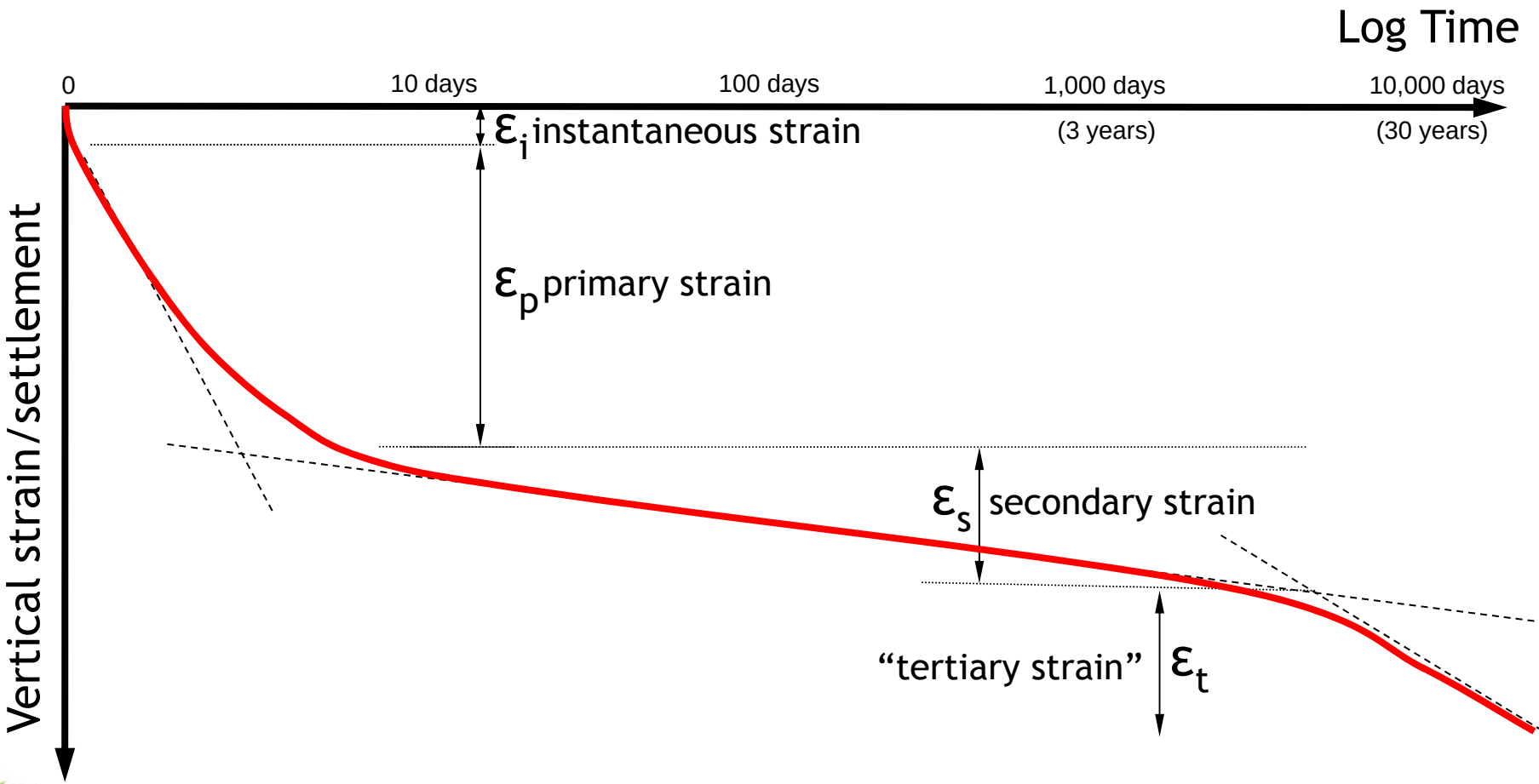
Effects of new drains on a floating road

P Carlsten SGI

Engineering considerations of peat:



Behaviour of peat when loaded: Strain/settlement



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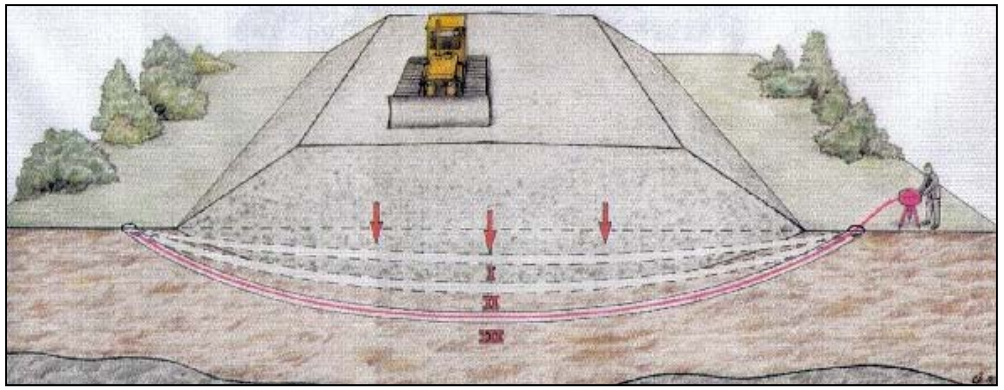
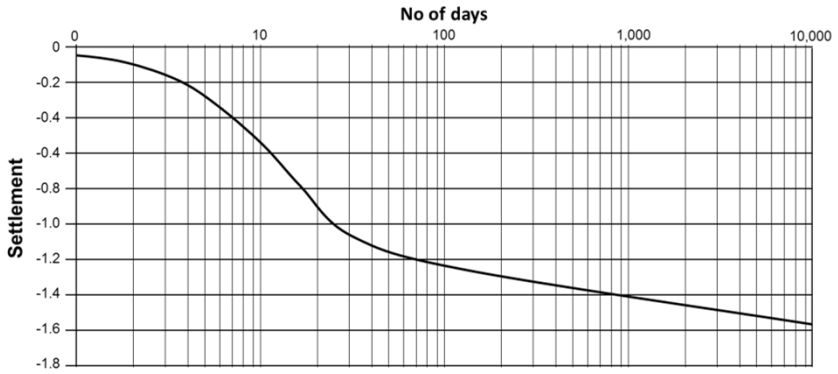
Behaviour of peat when loaded:
Monitoring of settlement

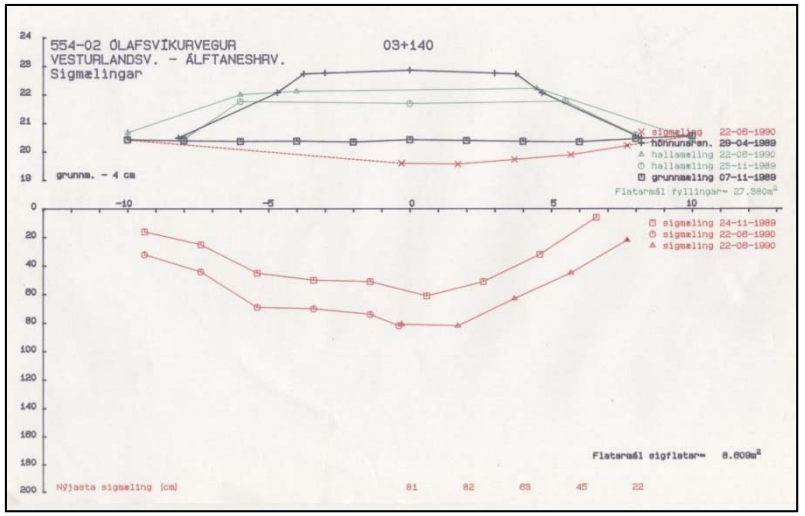
Settlement plate
- simple plate and rod



CONSOIL Hydrostatic Profiler
- polyethylene tube with a portable pull-through sensor



Settlement plate v. log time



Tube settlement cross-section, Iceland

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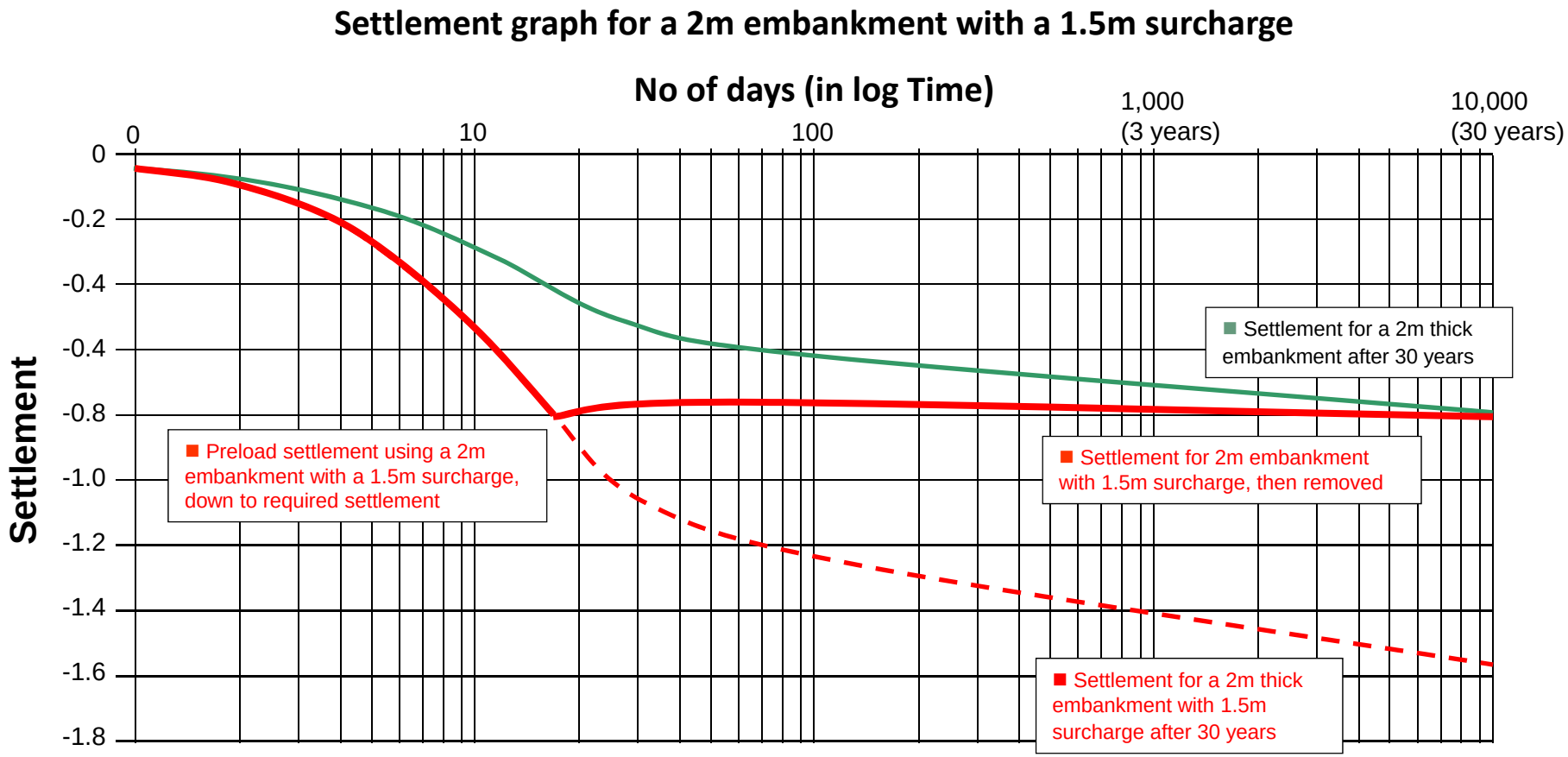
Behaviour of peat when loaded: Preloading/strengthening



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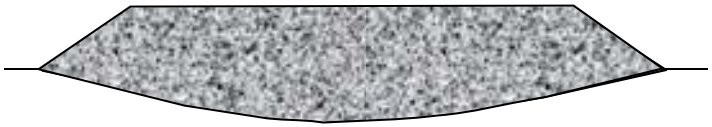
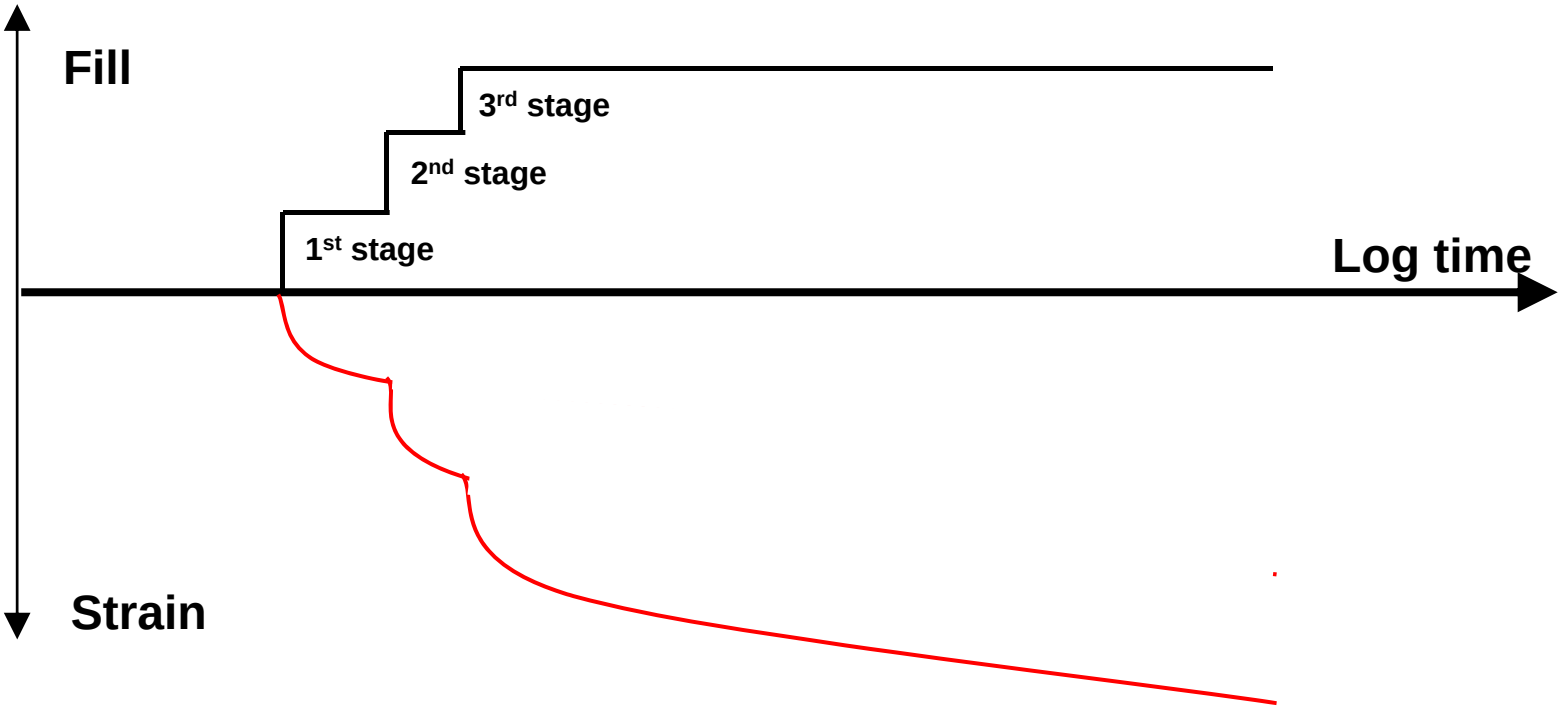
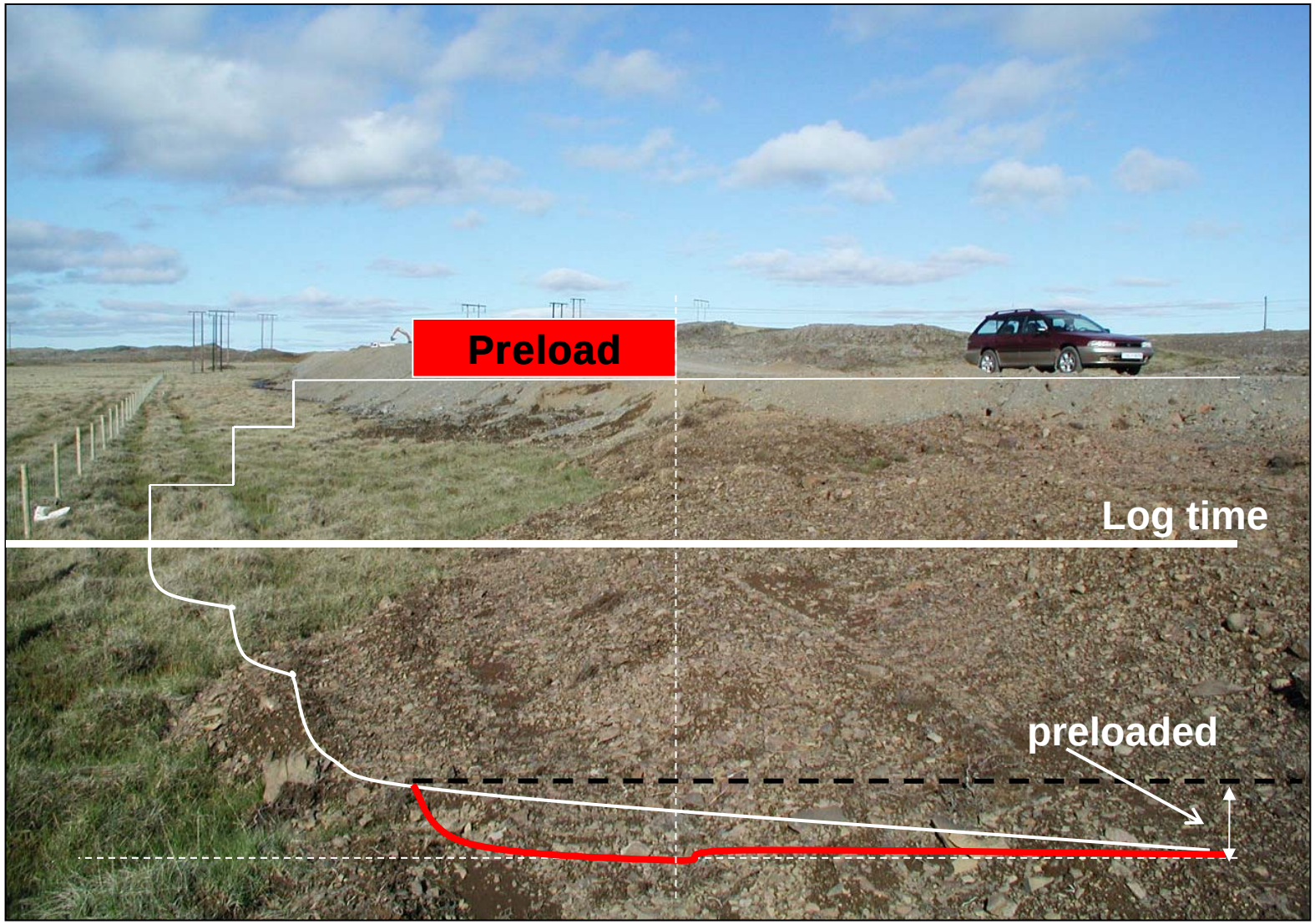
Loading peat: Stage construction



Stage construction embankment



Icelandic preload method:
Preloading Method



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Investigations and surveys

Minimum:

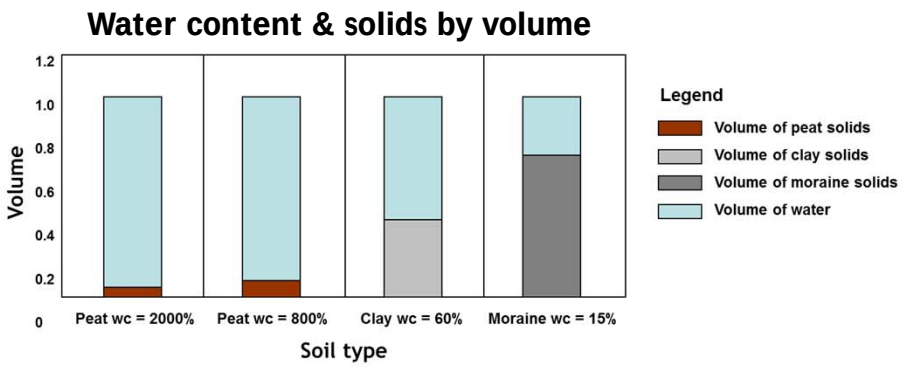
- Desk study
- Site walk through
- Depth probing (or GPR)
- Sampling for
  - Classification
  - Water content

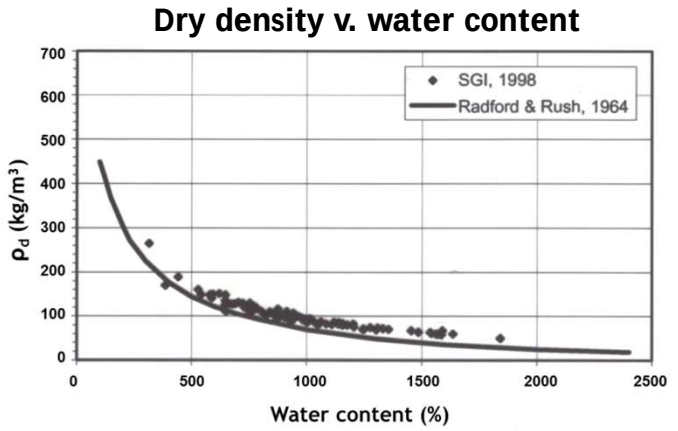
Steel rod probing for depth

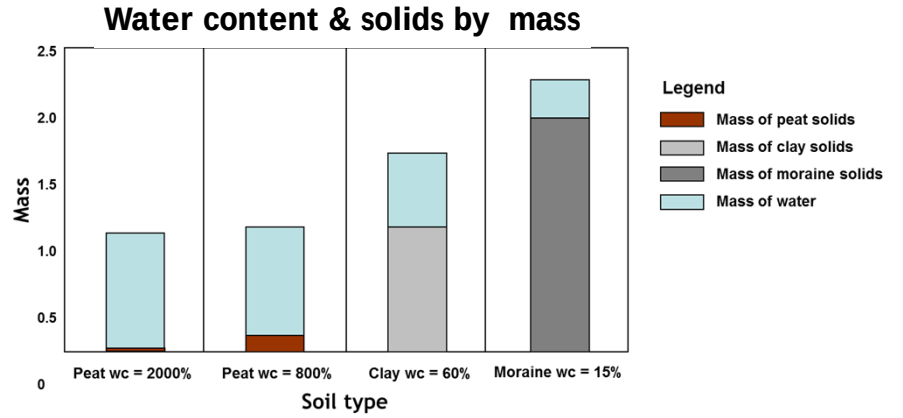
Von Post classification

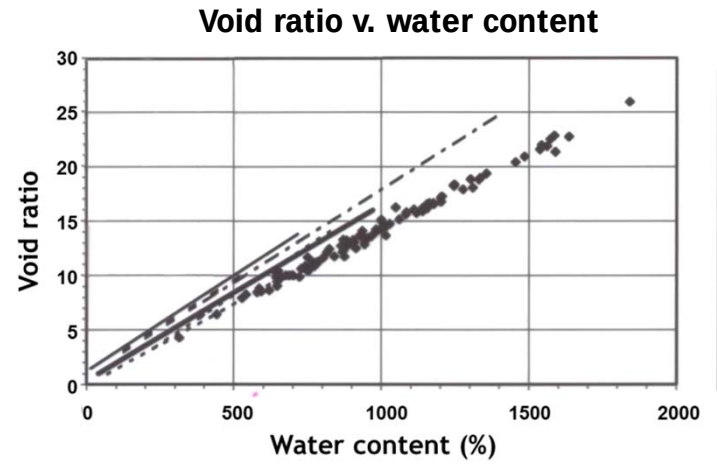
SGI core sampler

Water content influences:









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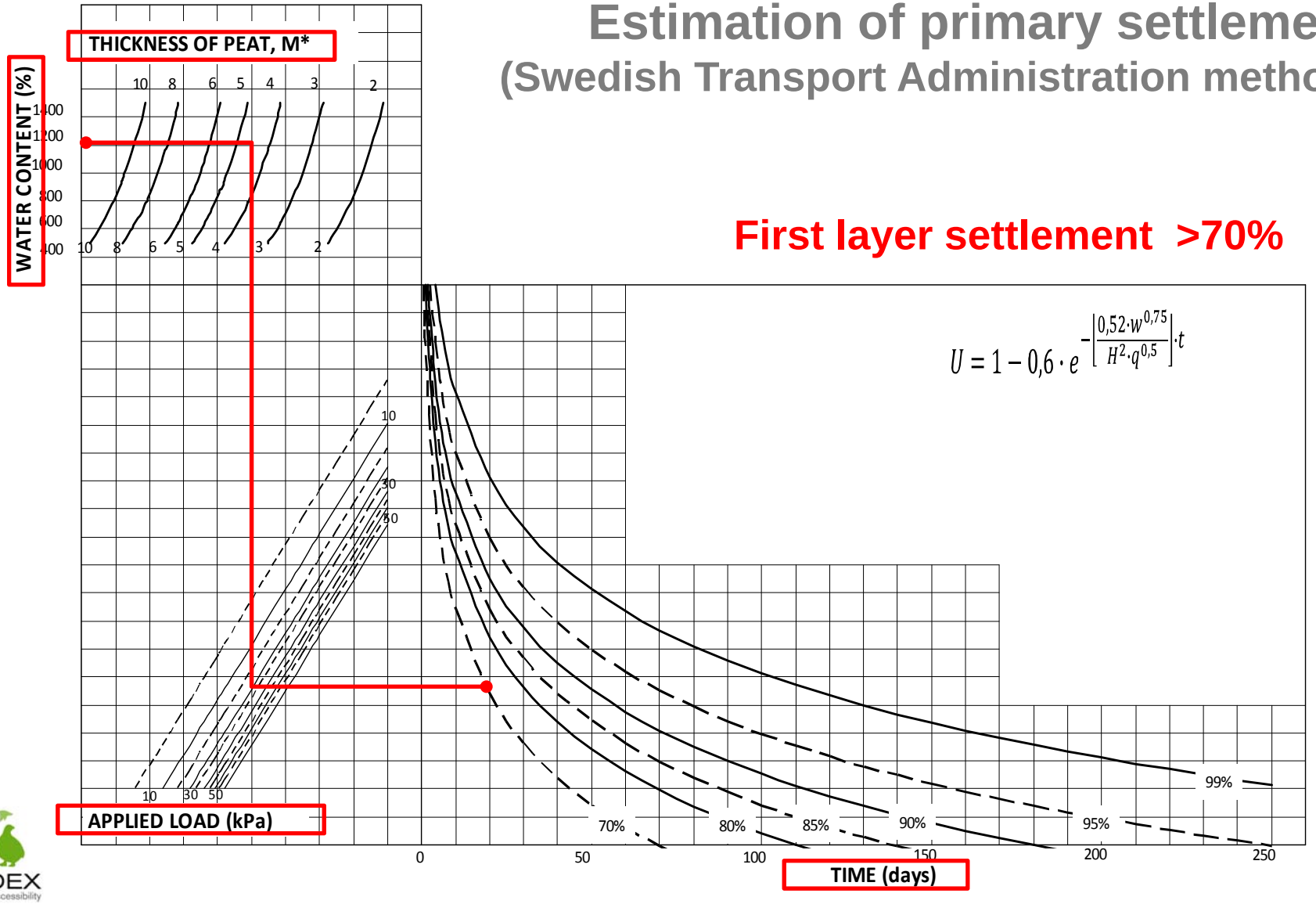
Roads on peat

Estimation of primary settlement
(Swedish Transport Administration method)

First layer settlement >70%



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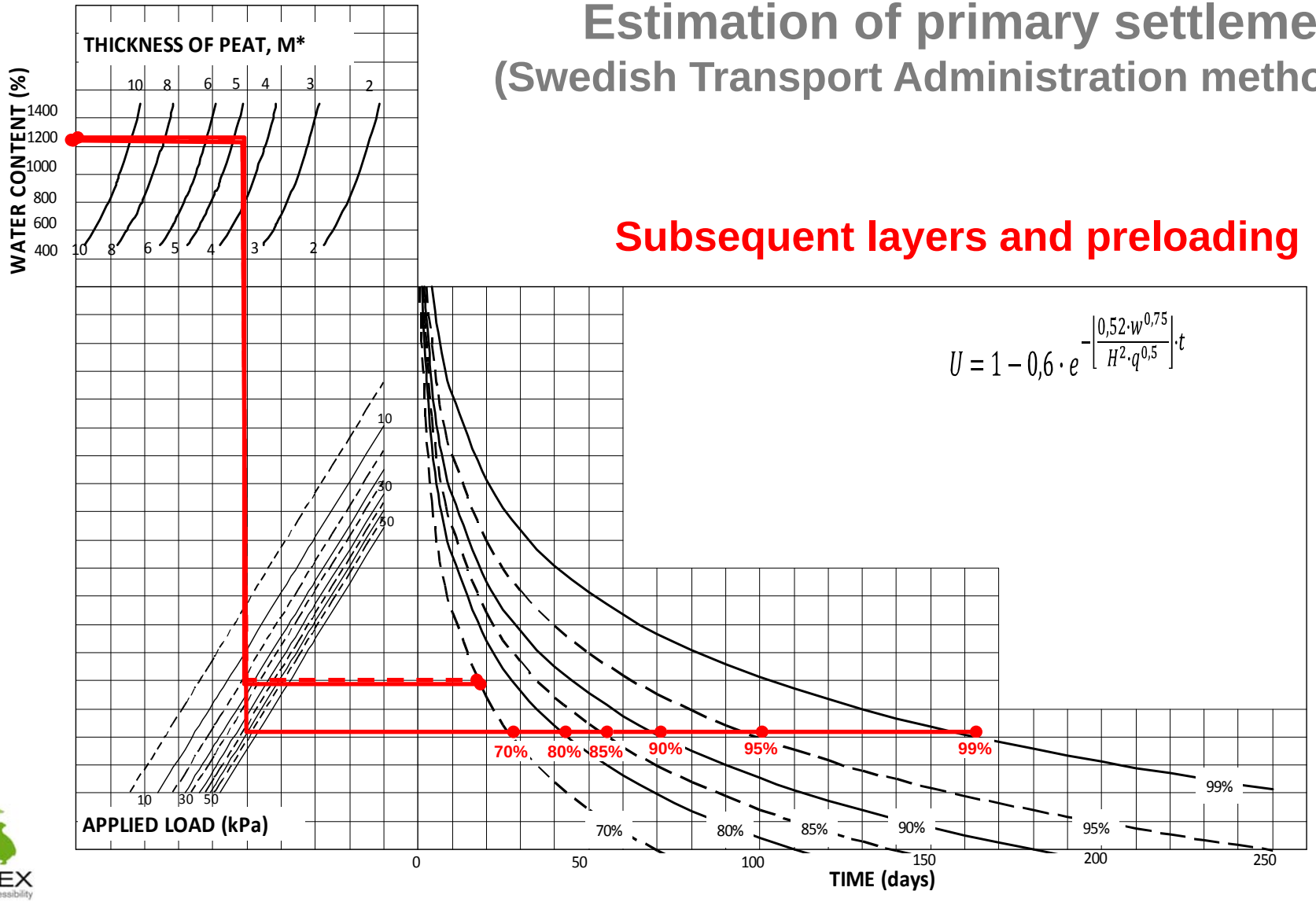
Roads on peat

Estimation of primary settlement
(Swedish Transport Administration method)



Subsequent layers and preloading

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Risk Management

- Experienced designers
- Experienced contractors
- Good planning
- Awareness of the hazards and impacts
- Sound mitigation measures
- Careful construction techniques
- Contingency planning
- Monitoring of the work on site

Geotechnical risk management

Geotechnical risk management

"*No construction project is risk free. Risk can be managed, minimised, shared, transferred or accepted. But it cannot be ignored*"

'Constructing the Team' report, 1994

Ways of managing risk:

Avoiding it – by eliminating the uncertainty or using an alternative approach.

Transferring it – by transferring the liability of the risk to another party, e.g. a specialist sub-contractor or consultant.

Mitigating it – by reducing the risk to an acceptable level by making it less likely that the event will occur.

Accepting it, and managing it – by accepting that the risk is reasonable given the cost, or the effect on time or quality, or life.

Geotechnical risk management

The Geotechnical Risk Register

Risk (R) = Probability (P) x Impact (I)

PROBABILITY (P)		IMPACTS (can be amended to suit contract circumstances)		IMPACT (I)	
		Either TIME dependent	or COST dependent		
Very Likely >75%	5	>10 weeks added to planned completion date	>€1M	Very high	5
Likely 50-75%	4	>4 weeks added to planned completion date	€100K to €1M	High	4
Probable 25-50%	3	>4 weeks<1wk added to planned completion date	€10k to €100k	Mediu m	3
Unlikely 10-25%	2	1 to 4 weeks on activity: no change to planned completion date	€1k to €10k	Low	2
Negligible <10%	1	<1 week to activity: no change to planned completion date	<€1000	Very low	1

Calculated RISK R=PxI	Degree of Risk	Suggested Action
17 to 25	Unacceptable	If risk cannot be reduced project should not proceed
13 to 16	Unacceptable	Work must not start until risk has been reduced
9 to 12	Significant	Reduce risk. (Mitigate or transfer.)
5 to 8	Tolerable	Consider risk reduction measures
1 to 4	Trivial	Monitor work

Hazard: an activity or condition with a potential for adverse consequences.

Risk: the potential that the hazard will lead to a loss - generally expressed as “probability” x “impact”, or “likelihood” x “consequence”

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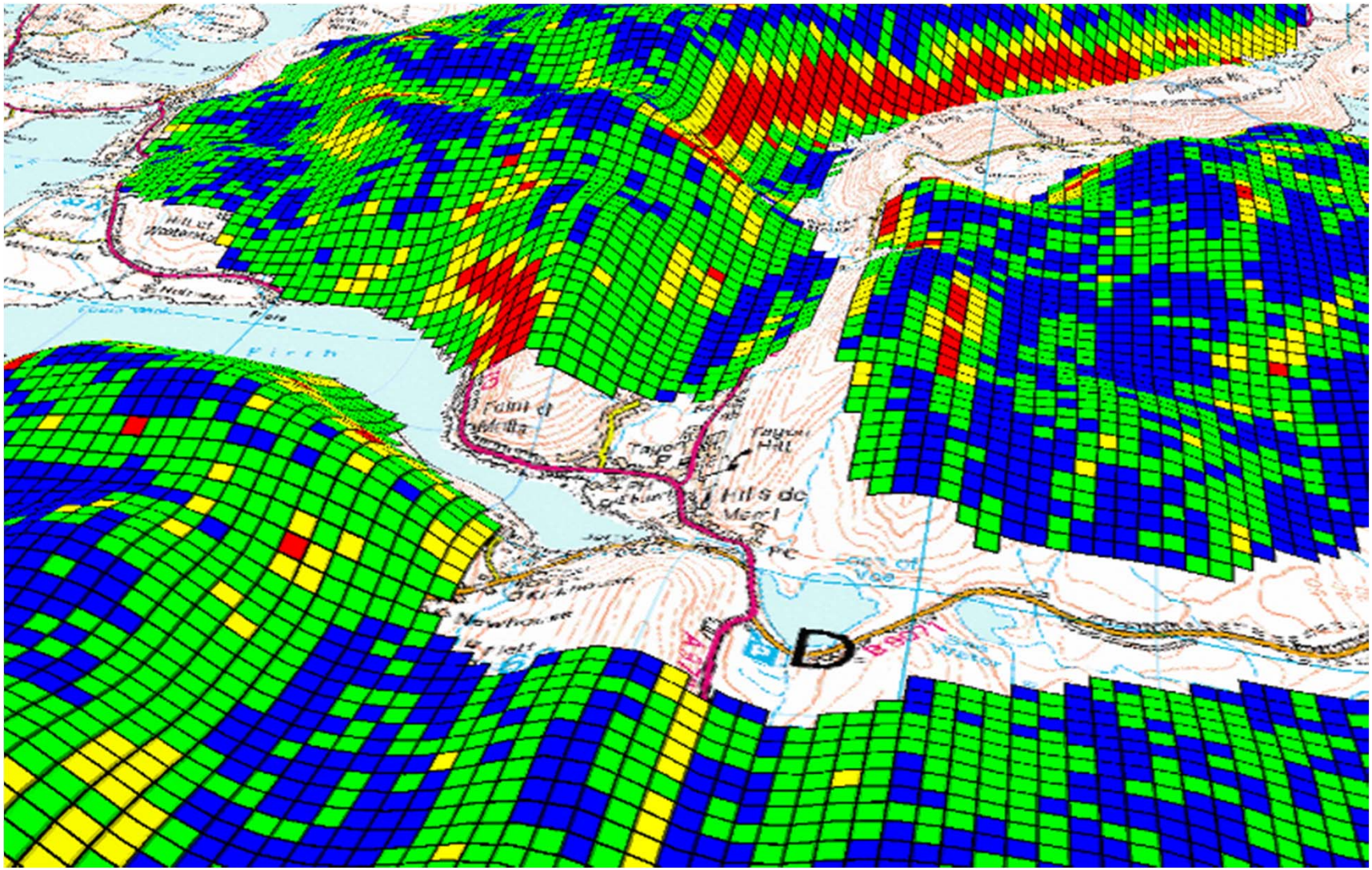
Susceptibility mapping for peatslide



Mouchel, SNH/FCE seminar 2009

Geotechnical risk management

The Geotechnical Risk Register

Risk (R) = Probability (P) x Impact (I)

Geotechnical Risk Register

No	HAZARD	CAUSE	BEFORE CONTROLS			CONSEQUENCE	RESPONSE (avoid, transfer, mitigate, accept & manage)	AFTER CONTROLS		
			P	I	R=PxI			P	I	R=PxI
1	Unexpected ground conditions	Ground conditions encountered on site differ from those indicated in the project ground investigation.	3	3	9	Construction delayed. Design review required with possible changes in design. Project cost and timescale increased	Monitor works in progress. Use experienced staff on site. Ensure that site staff are aware of the results of the ground investigation and the basis of the design of the permanent Works	3	1	3
2	Flooding	Prolonged rain, Rise in groundwater levels within bog. Local watercourses break banks.	3	4	12	Permanent works damaged. Work stops. Increased costs for repair of the Works. Project delayed	Ensure that cut off drains are installed and serviceable. Monitor weather forecasts and take action in light of forecasted poor weather	2	2	4
3	Site clearance	Clearance of vegetation from within the site limits ahead of the permanent Works	4	3	12	Damage to fibrous surface of peatbog. Removal of surface rootmat. Design of Works affected	Use low ground pressure construction plant. Ensure that site staff are aware that existing root mat has to be retained as reinforcement	2	1	2
4	Placing of fill on geotextile	Rupture, puncture or tearing of the permanent geotextile	4	4	16	Damage to permanent Works. Fill material laid directly on to bog surface. Failure of subgrade	Protect geotextile with layer of fine material. Ensure that site staff are aware of need to protect geotextile during installation	2	1	2

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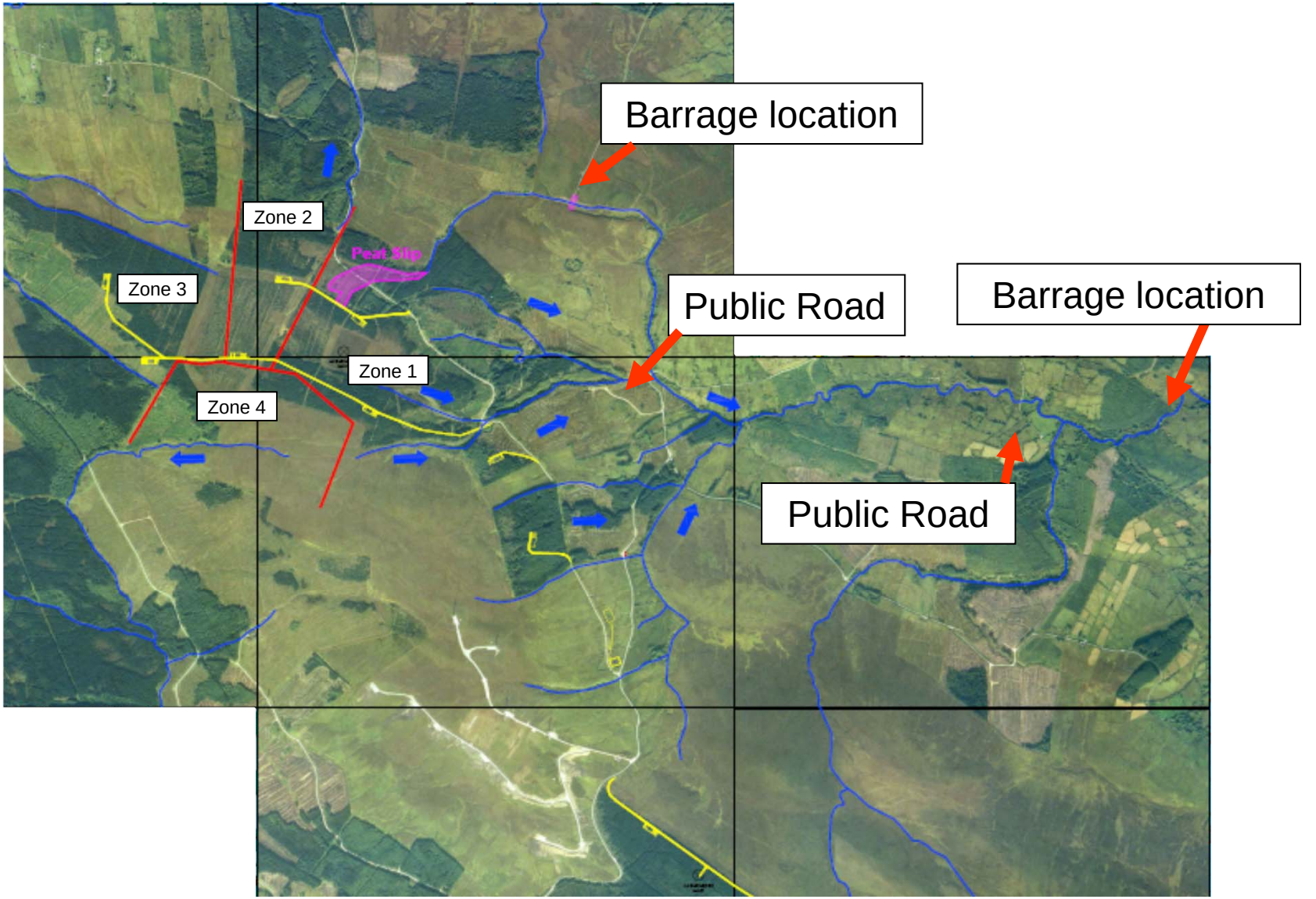
Contingency planning:



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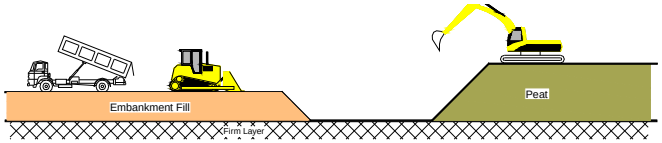
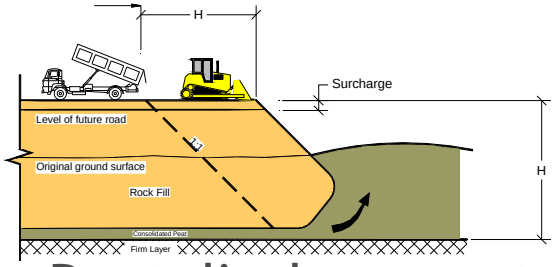
ROAD CONSTRUCTION

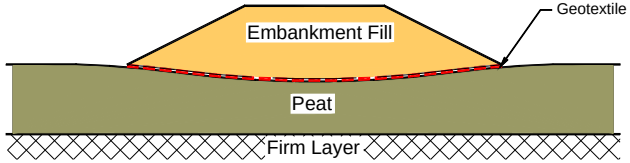
Methods of construction



Peat excavation



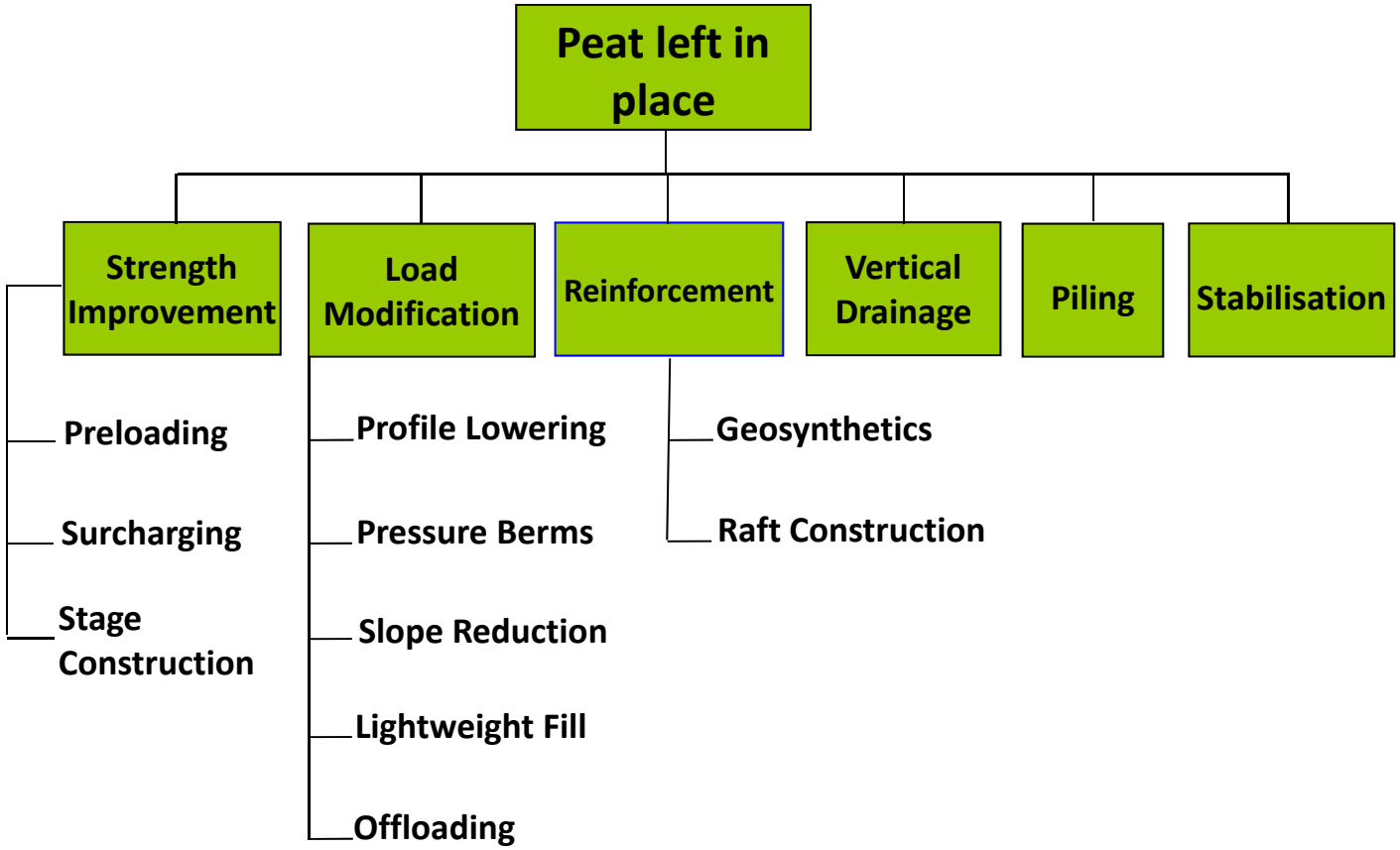
Peat displacement



Peat left in place

ROAD CONSTRUCTION

Methods of Construction – Peat left in place



Budget v. Timing:

Advance earthworks ahead of road construction – add 3 years

Vertical drainage to speed settlement – add €€€€€

2-lane road in Iceland constructed by preloading – 1 year

Low volume wind farm road immediate loading by 150 tonne trucks

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Examples of practices in the ROADEX areas

ROADEX demonstration project

Assessment of an existing roads on peat

N59 Newport – Mulranny, Co Mayo, (15km)

The ROADEX method:

- **Map the weak sections of road and FOCUS in on them**
- **Understand the processes causing the problems**
- **Innovate - find new 'fit for purpose' structures and treatments**

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ROADEX demonstration project

N59 Newport – Mulranny, Co Mayo, (15km)

Surveys March 2011:

- standard GPR survey in both directions
- deep GPR survey for presence of peat in both directions
- GPR cross-sections at selected locations
- laser scanner survey in both directions
- FWD survey in one direction at 50m centres

GPR, GPS, laser scanner & video

FWD testing

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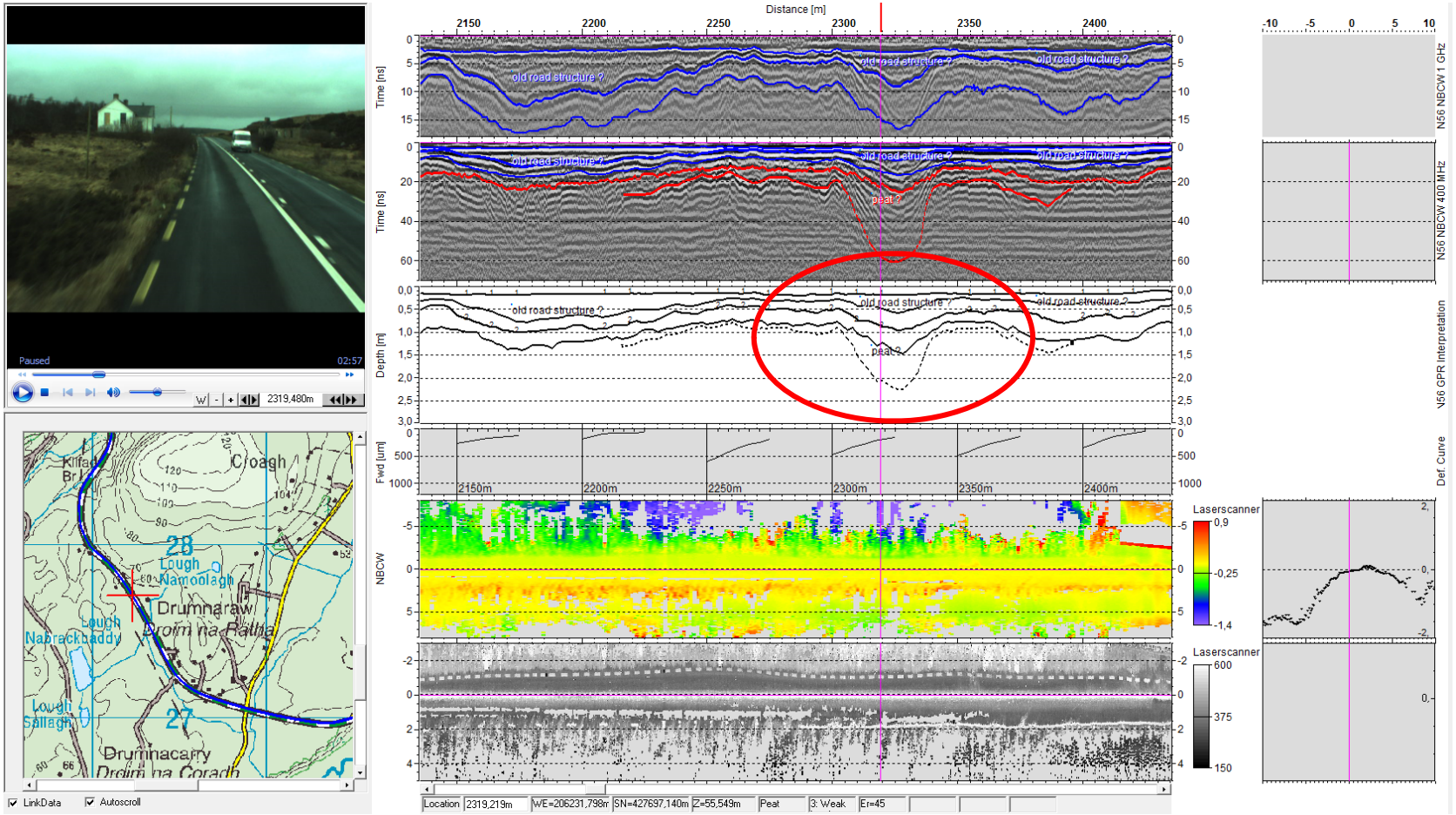
ROADEX demonstration project



40m long pocket of peat under an existing road

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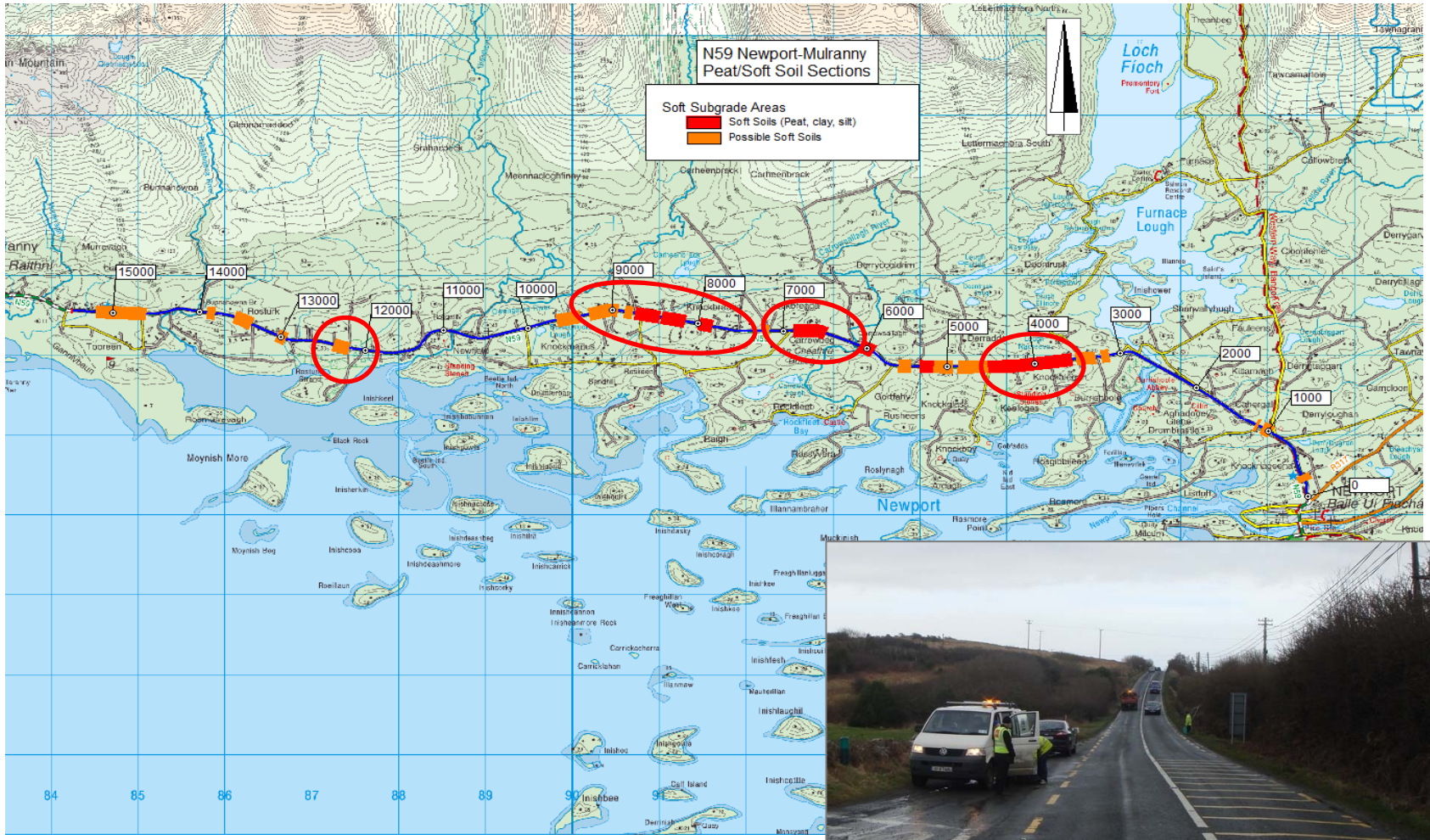
Example: N59 Newport – Mulranny



GIS map of SOFT SUBGRADE areas
N59 Newport to Mulranny
County Mayo

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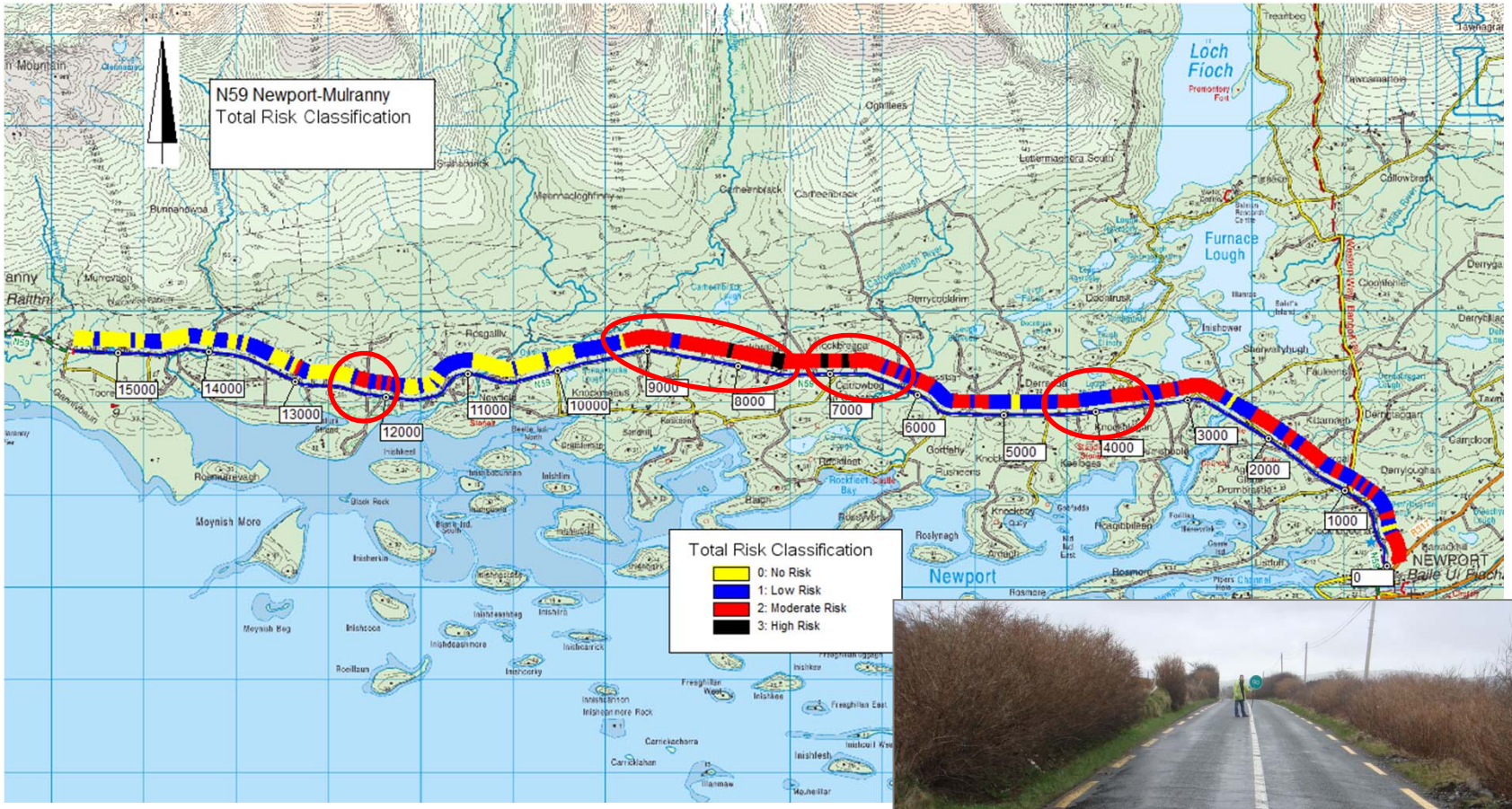
Example: N59 Newport – Mulranny



TOTAL RISK CLASSIFICATION
N59 Newport to Mulranny
County Mayo

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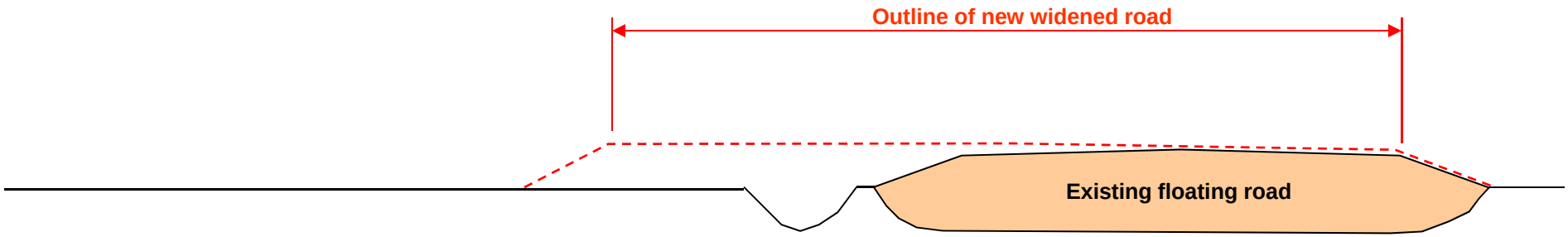
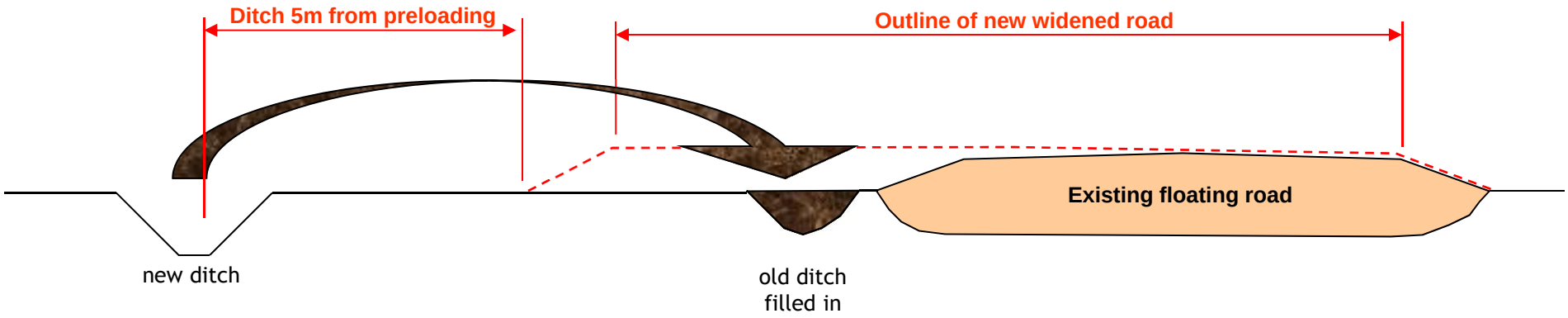
Roads on Peat

Widening an existing road



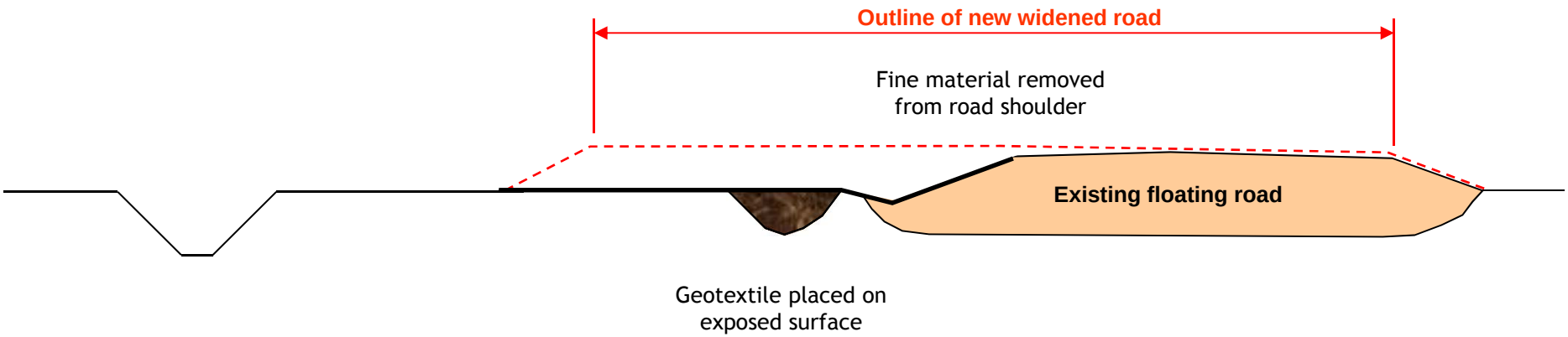
Roads on Peat

Widening an existing road



Roads on Peat

Widening an existing road



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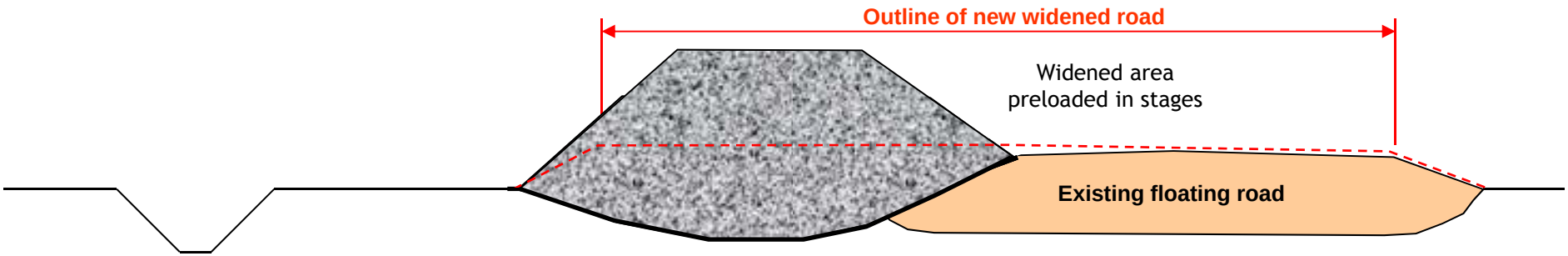
Widening an existing road



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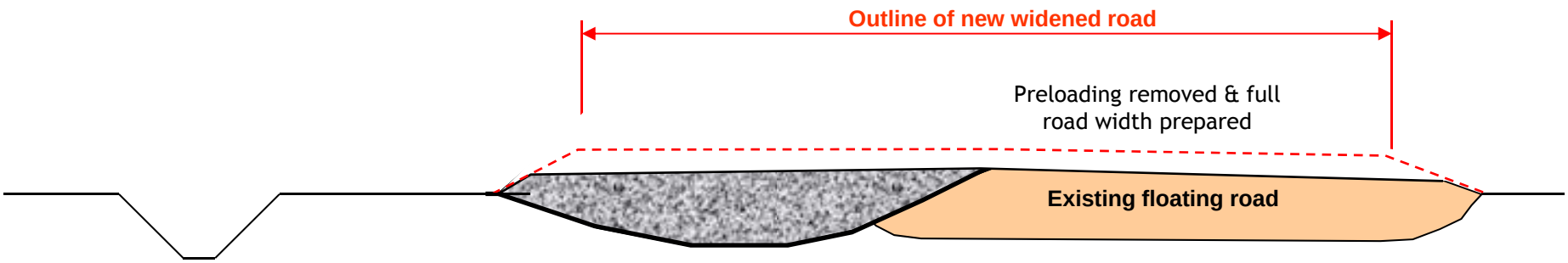
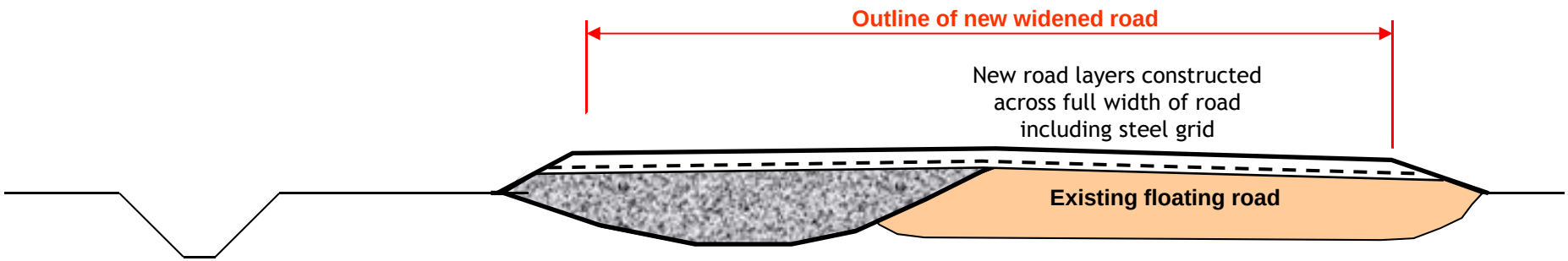


Roads on Peat

Widening an existing road



Roads on peat - summary

- Collect data
- Understand the ground conditions
- Respect the established hydrology
- “Do no more harm”
- Think about geotechnical risk management
- Monitor the works during and afterwards
- Keep records & share knowledge

ROADEX II: B871 Rosail embankment replacement

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Thank you

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