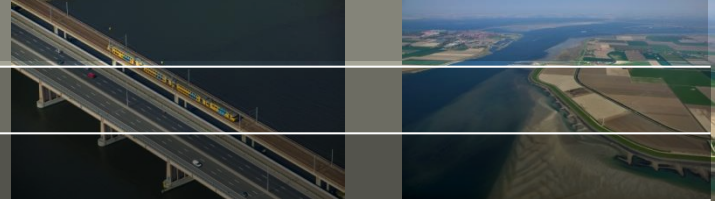




Dutch experiences in urban groundwater control

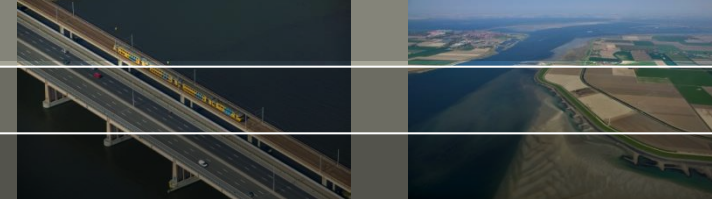
Jelle Buma

Temadag om stigende grundvand i byer
23/08/2018, Aarhus



- a long history of drainage
 - causes of urban groundwater rise
 - organisation of water management
 - groundwater legislation (2008)
 - signature case study: Hoogeveen
 - more case studies ('specials')
 - conclusions
-
- focus on existing urban area
 - focus on rising urban groundwater

history



digging
channels



dike
building



windmill
drainage



mechanical
drainage



a long history of drainage

1000 AD 1200 1400 1600 1800 2000

digging
channels

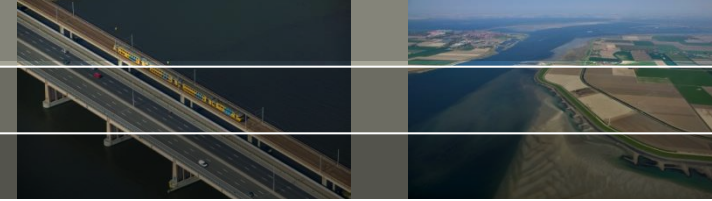
dike
building

windmill
drainage

mechanical
drainage

van de Ven, G. P. (1993), Man-Made Lowlands: History of Water Management and Land Reclamation in the Netherlands, Uitgeverij Matrijs, Utrecht, Netherlands.

history



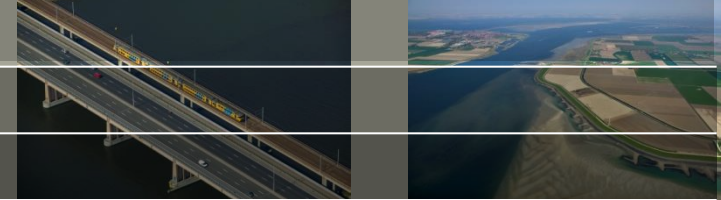
(Gemeentearchief Rotterdam)

rural drainage:
the giant land swap 1950-80
(for a secure food supply)

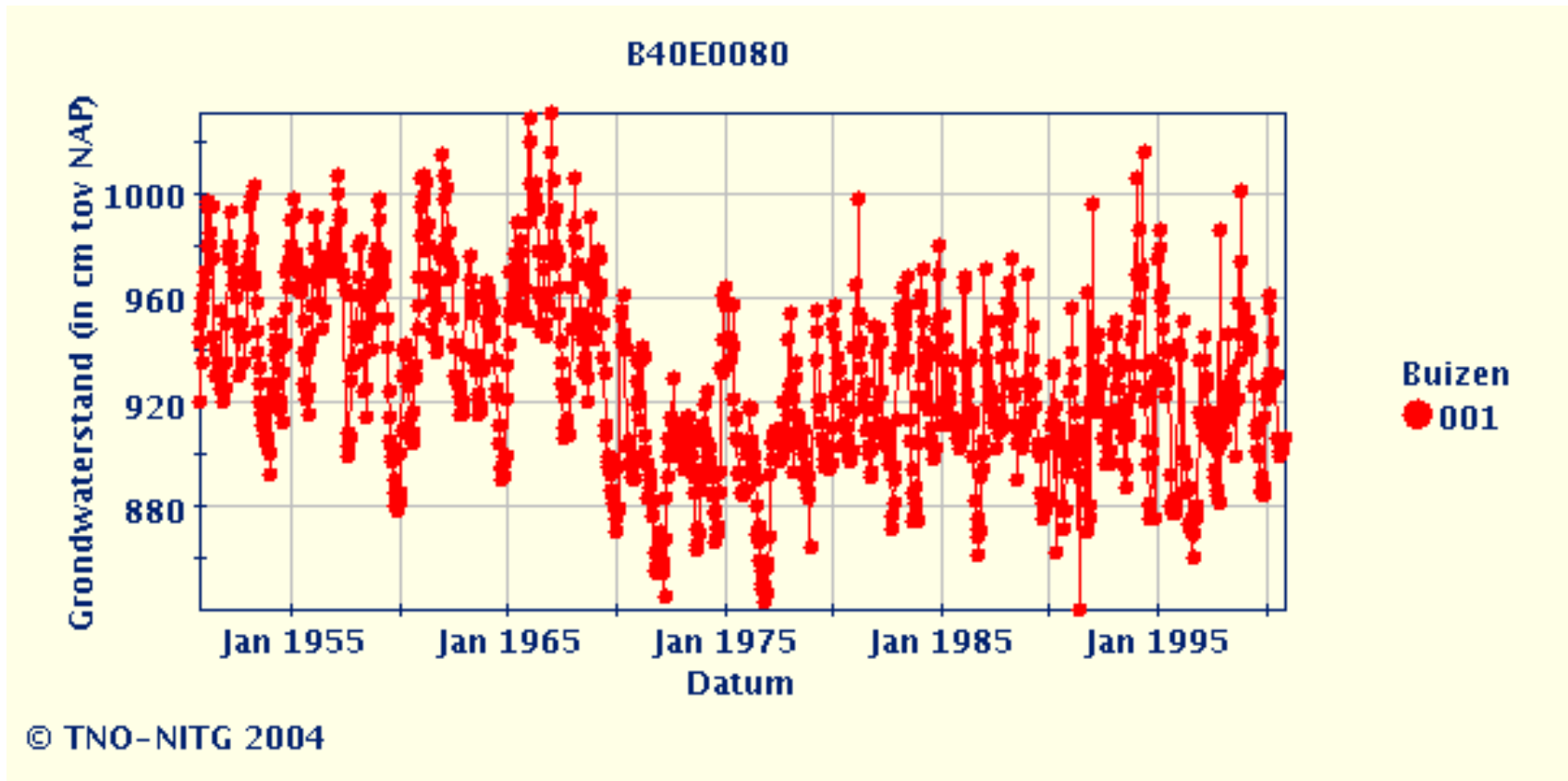


(www.npogeschiedenis.nl)

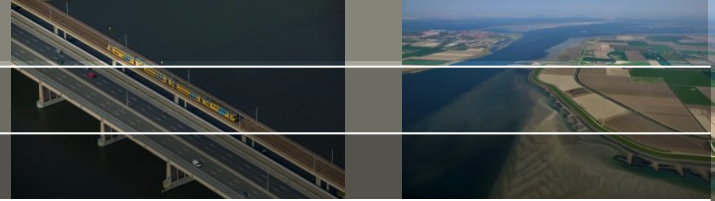
history



rural drainage (1950-80):
overall groundwater decline



history

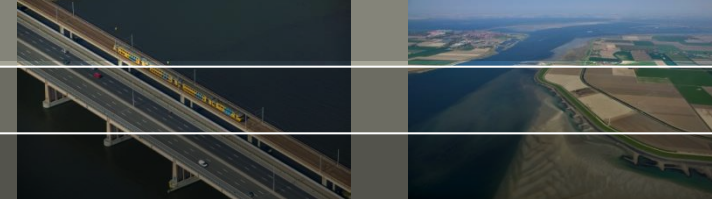


rural drainage:
the farmer drains (for his own benefit)

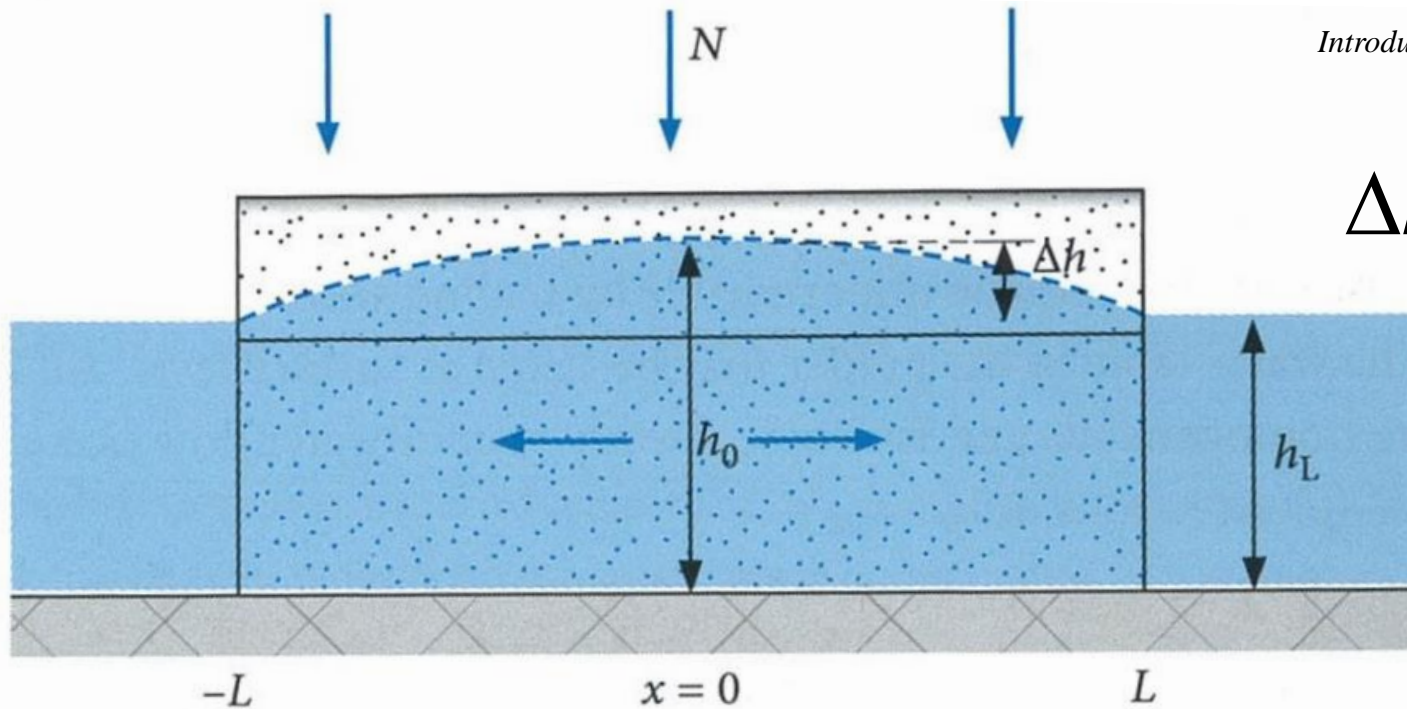


Waterschap Drents-Overijsselse Delta (website)

history



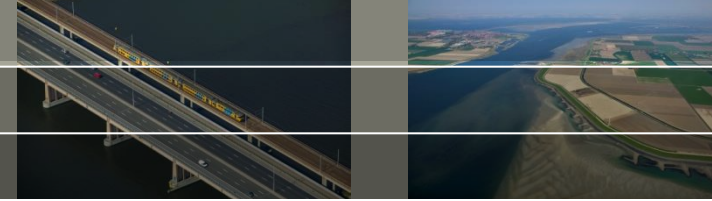
Hendriks MR (2010)
Introduction to Physical Hydrology



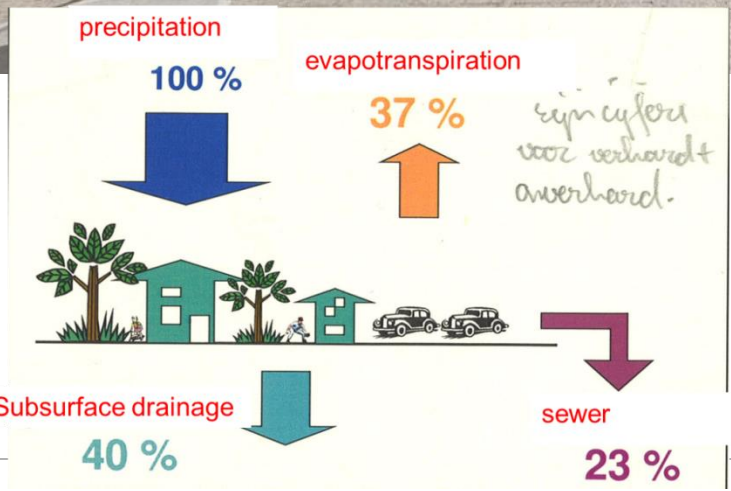
$$\Delta h \approx \frac{NL^2}{2KD}$$

side step 1, basic theory:
the importance of drainage distance ($2L$)

history



side step 2: urbanisation ≠ less groundwater recharge



Ontwatering in Stedelijk Gebied (SHR publication, 2007)

history

after WW II:
huge housing deficit

'quick & dirty' building:

- ditches closed
- L increases
- no soil improvement

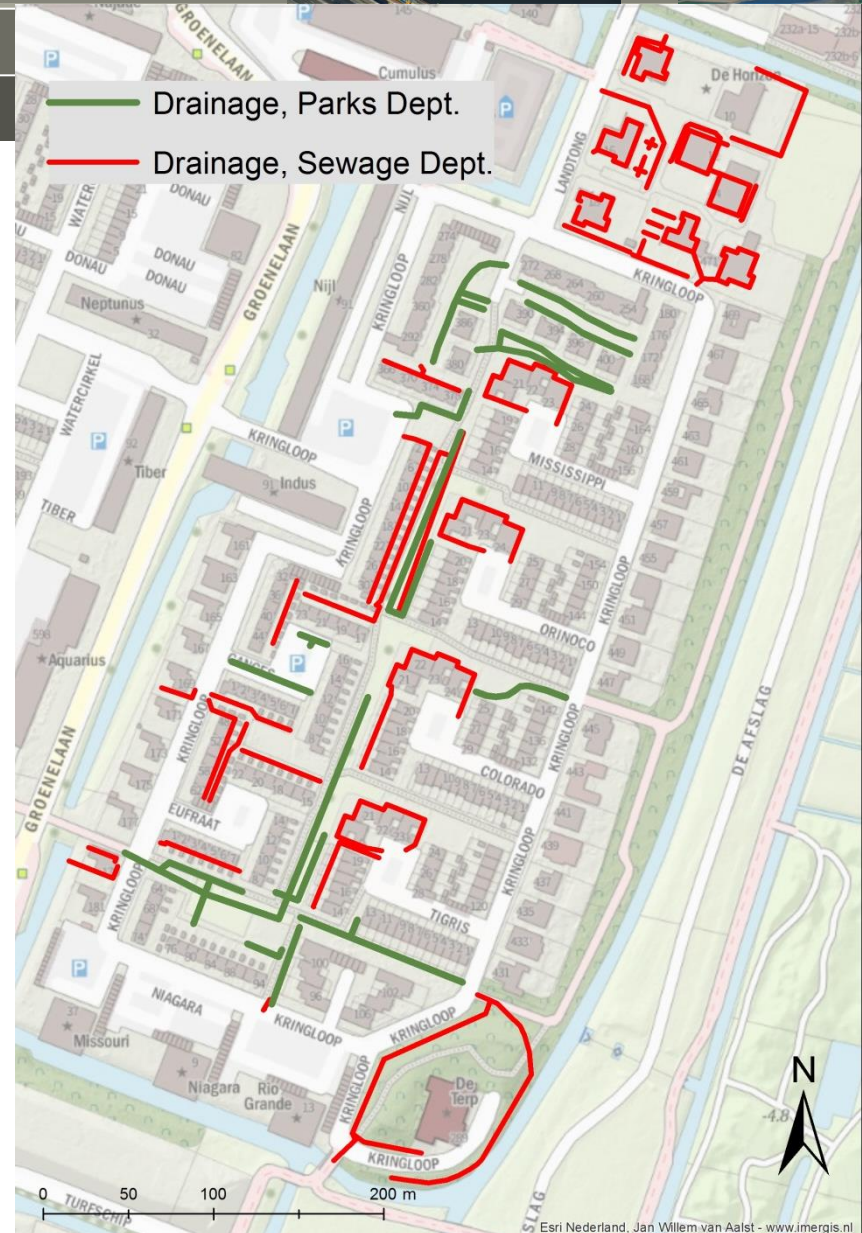
$$\Delta h \approx \frac{NL^2}{2KD}$$



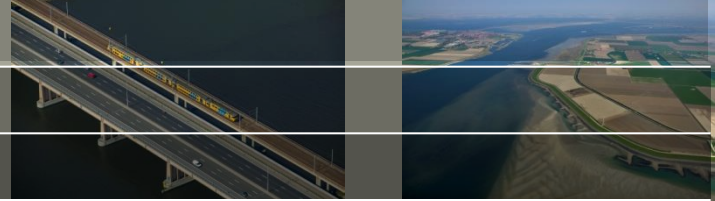
causes of gw rise

the result:

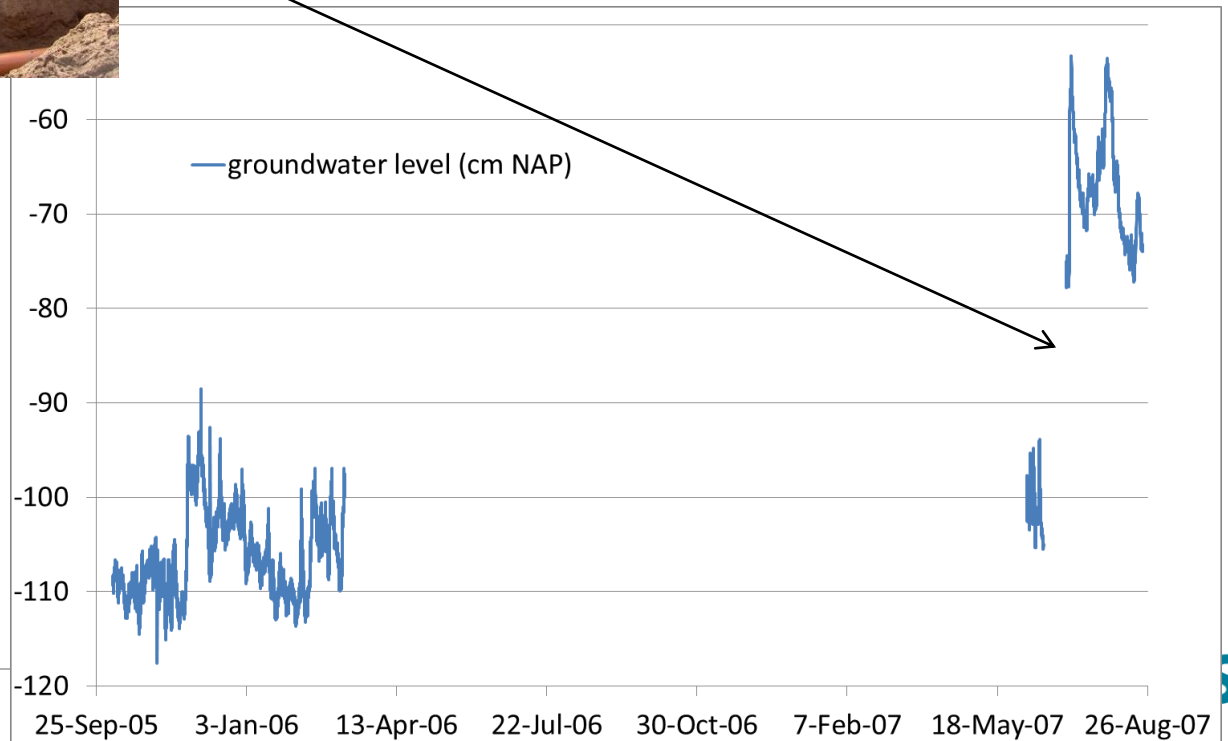
- groundwater flooding
- many complaints
- 'ad hoc' drainage
- additional costs



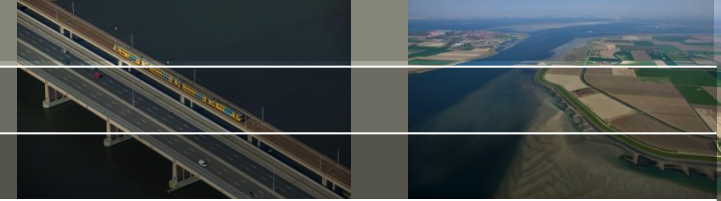
causes of gw rise



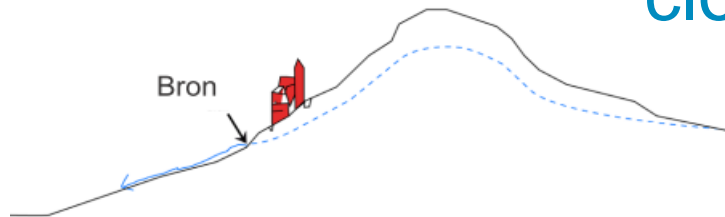
sewage replacement



causes of gw rise

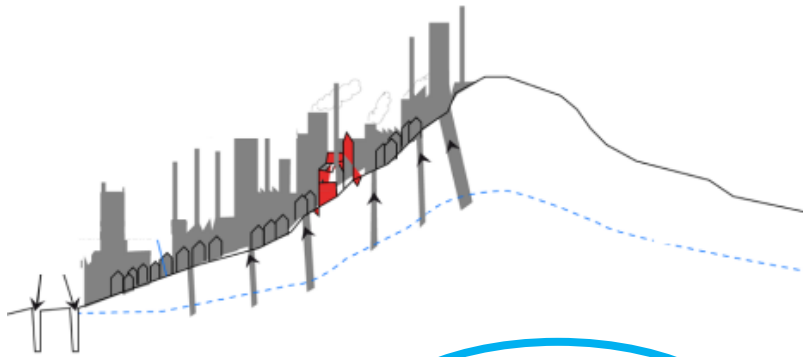


1850

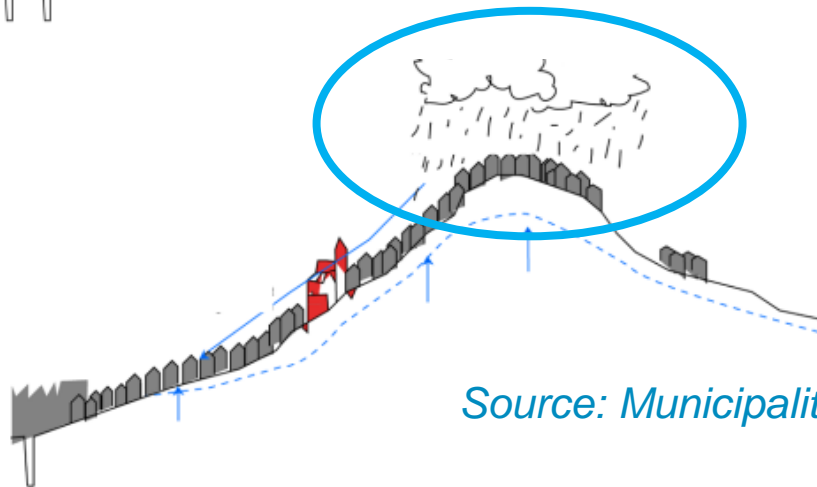


closure of gw abstractions
drinking water / industry

1930



2016



more rain !
(+25% since 1910)

Source: Municipality of Enschede

causes of gw rise

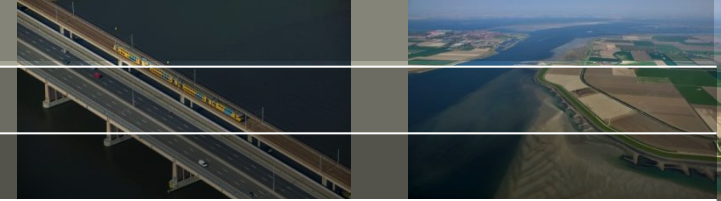
- civil engineering works
- interaction ground- /surface water



Binnenhof
Den Haag
(Dutch
Parliament
building

peat layer removed by dredging

infiltration....



Staat eist geld van Den Haag voor schade Binnenhof

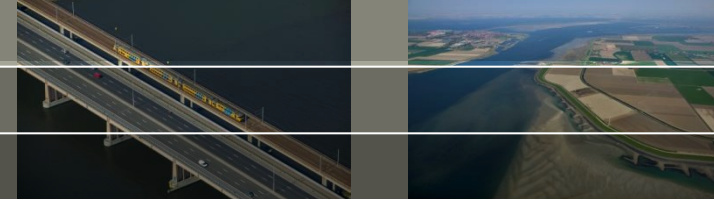
NRC 2001
Door een onzer redacteuren
DEN HAAG, 11 MEI. De Neder-
landse staat stelt de gemeente Den
Haag voor 2 miljoen gulden sprakelijk voor waterschade aan
Binnenhof sinds 1970. De
Rijksgebouwendienst heeft een
waterpeil onder het parterre van
35 centimeter gestegen. Het
komen door het uitbaggeren van
de Hofvijver naast de Eerste Ka-
mer in 1998 en de aanleg van de
Volgens TNO zorgt ook de
tramlijn voor een opstuwung
water in westelijke
naar schatting tien
De tramtunnel, ruim
meter lang, ligt dwars op
de stroomrichting van het grond-
water, waardoor het grondwater
niet wegkan. Een woordvoester
van de Rijksgebouwendienst
spreekt van een klein aandeel

0.9 M€



Deltares

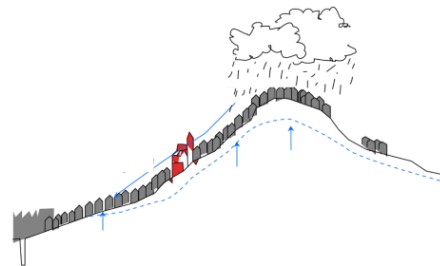
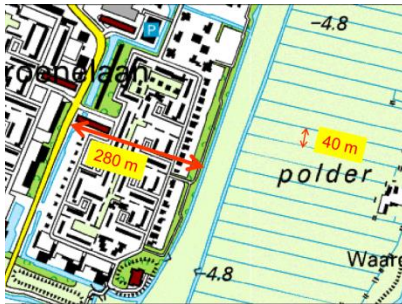
causes of gw rise



Observations:

most causes of groundwater rise are shallow
all causes of groundwater rise outshine sea level rise
elevation below / above sea level is not important

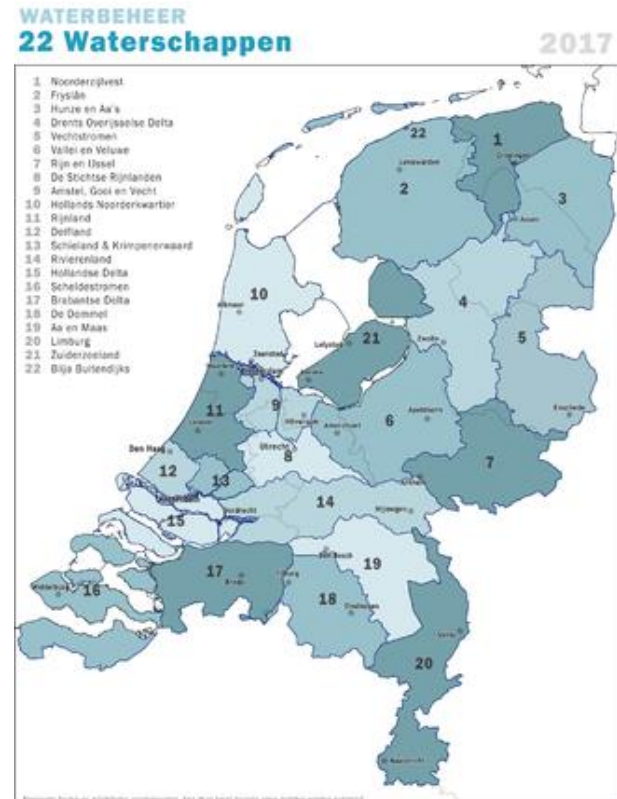
most causes of groundwater rise can not be
influenced by citizens

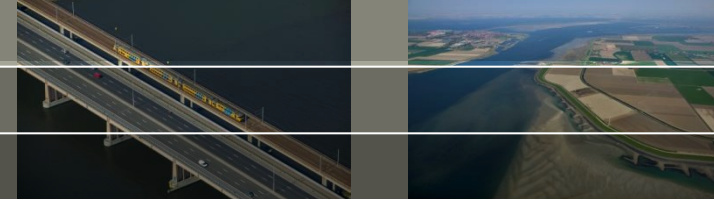


organisation

Water authorities:
12 provinces
>400 municipalities

22 water boards





1998

Source: RTV Drenthe

heavy rains, widespread flooding

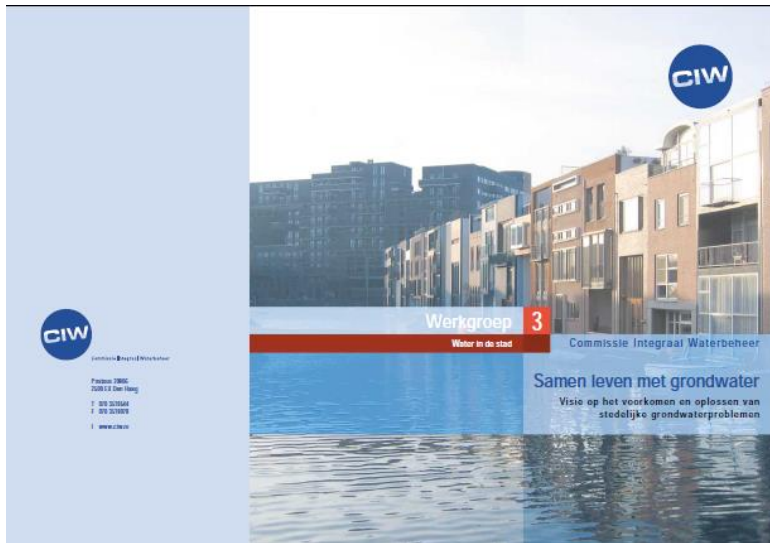
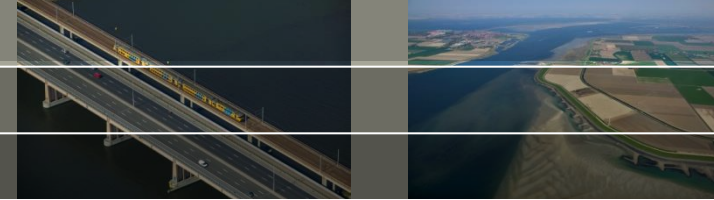
sense of urgency → National Water Agreement (2003)

between water authorities

“prepare water management for the 21st century”

urban groundwater: responsibilities unclear

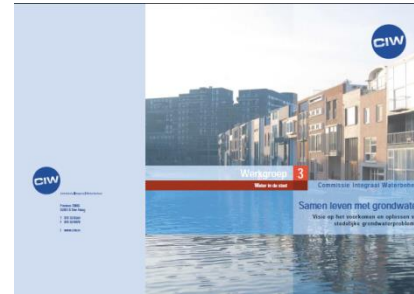
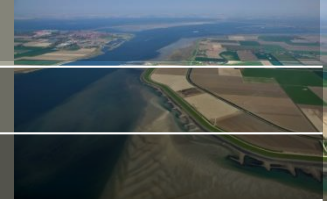
organisation



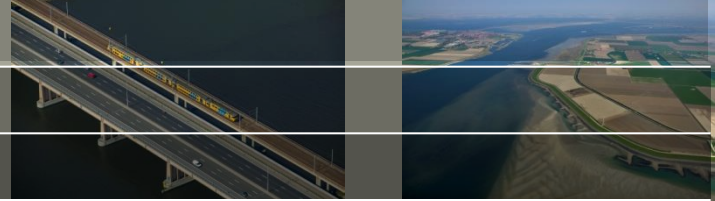
2004

Report by Commission Integrated Water Management :
>260,000 buildings affected by high groundwater
Estimated cost for NL: € 0.6 to 1.2 billion
Climate change will make it worse (more extremes)
Too little progress in tackling the problem

organisation



legislation (2008)

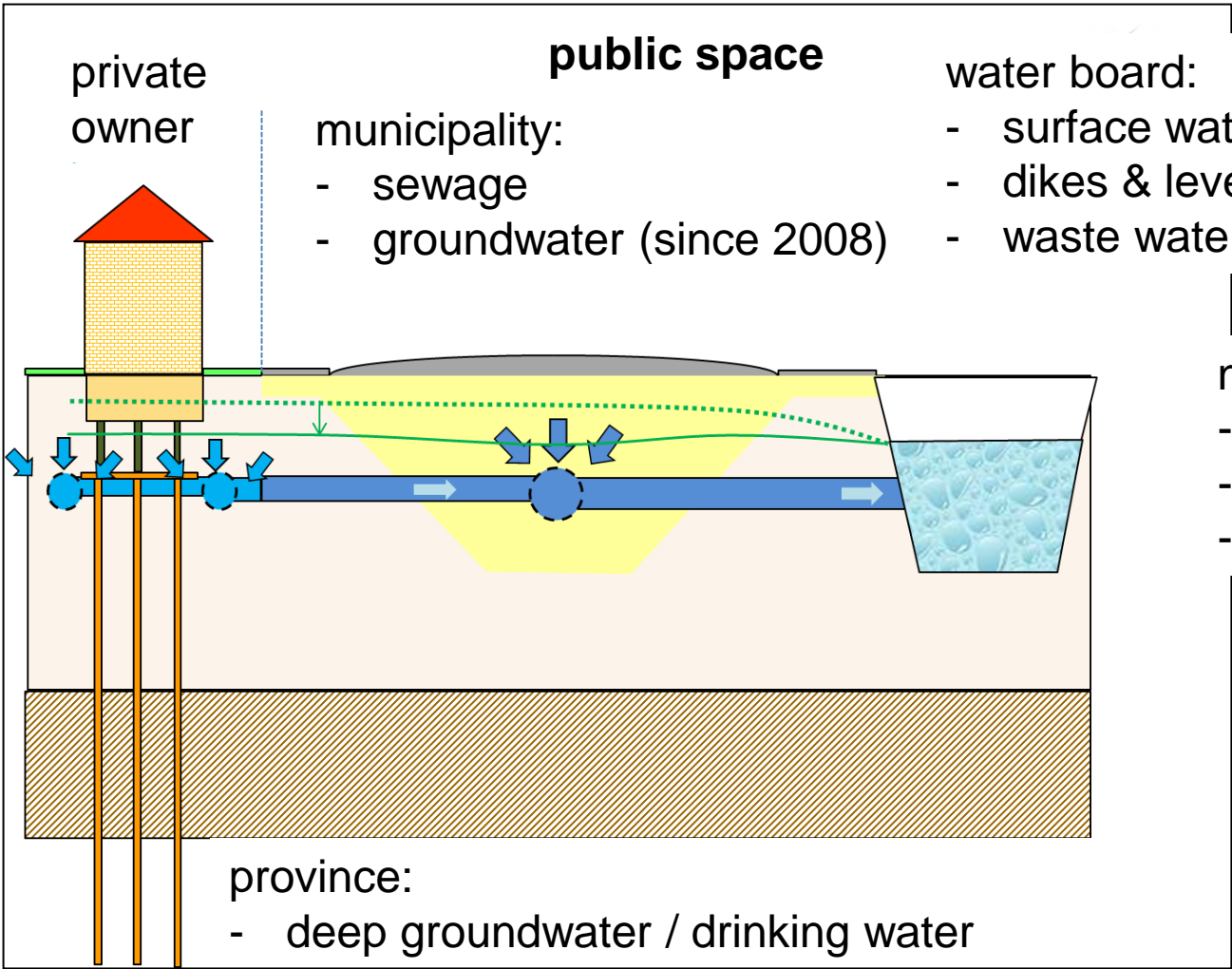
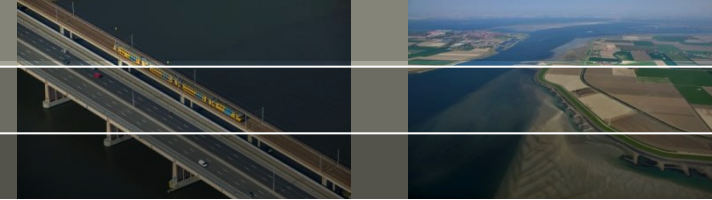


the Municipality is to take:

- hydrological measures
- in public area
- to reduce, as much as possible,
- structural negative effects of the gw level on the local land use
- as long as measures are cost-effective
- and no responsibility of any other water authority

to be refined locally

legislation (2008)



private owner

public space

water board:

municipality:

- sewage
- groundwater (since 2008)

- surface water
- dikes & levees
- waste water treatment

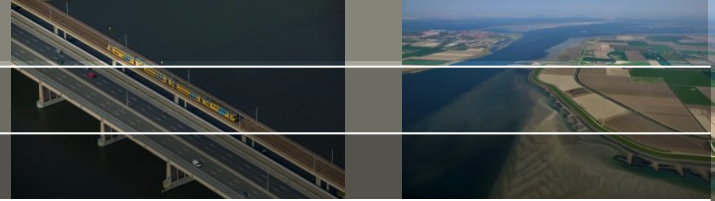
national:

- sea, rivers, big canals
- dike safety policy
- shipping

province:

- deep groundwater / drinking water

legislation (2008)

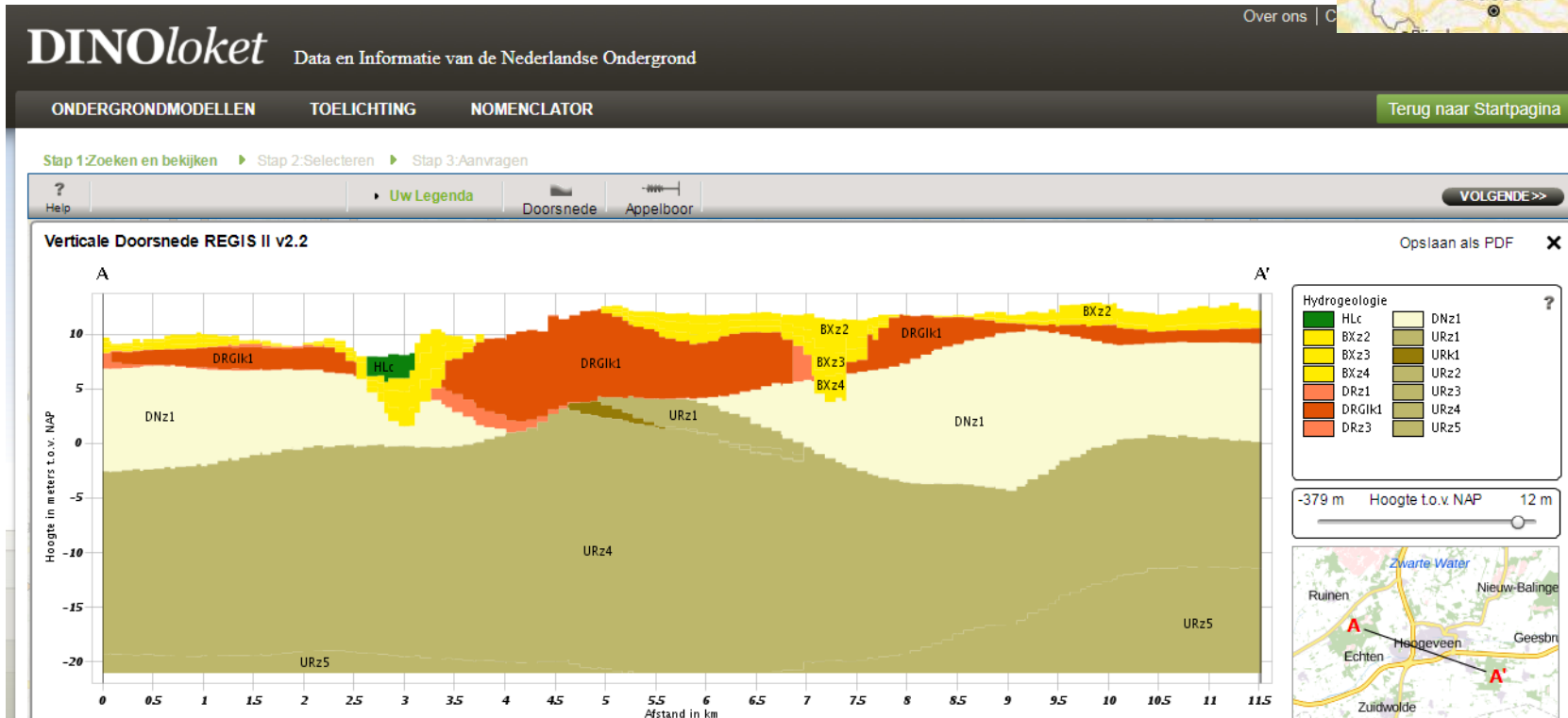


to be refined locally HOW ?

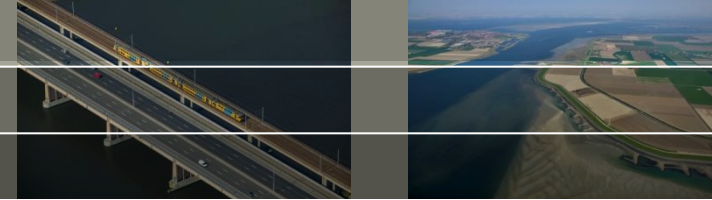
signature case study

case study: Hoogeveen (40,000 inhab.)

- 10 m above sea level
- unfavourable setting (glacial loam)



signature case study

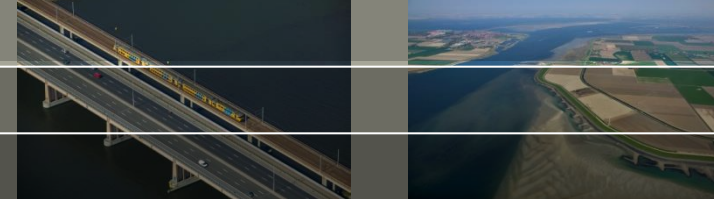


Legislation 2008 → (1) monitoring network (73 wells)
→ priority areas → interviews citizens → district plans



Gemeente Hoogeveen

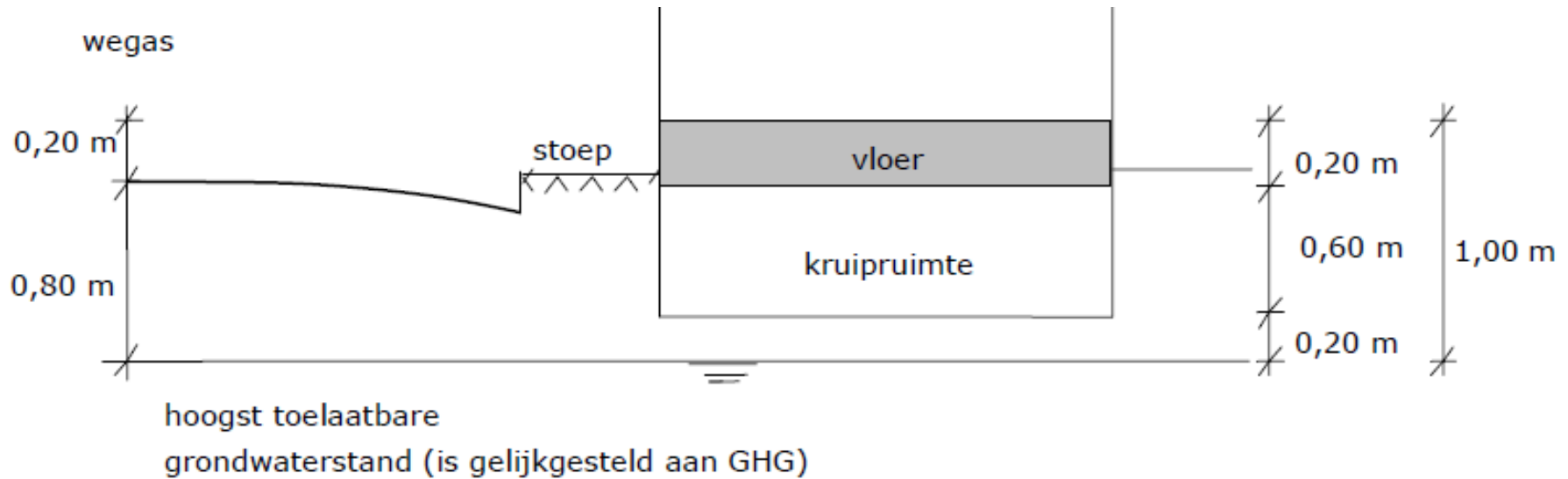
signature case study



Legislation 2008 → (2) gw management plan

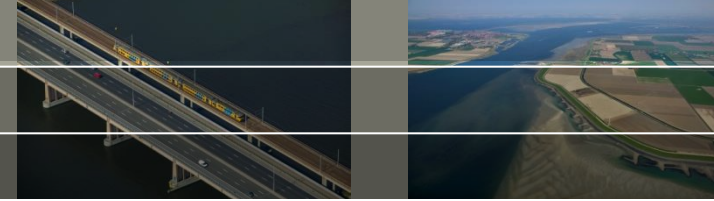
What is a 'structural' groundwater problem ?

- 'gw depth in winter' < 0.8 m
- regular negative impacts reported by citizens



Gemeente Hoogeveen

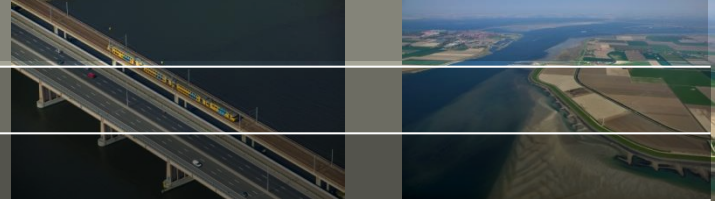
signature case study



Legislation 2008 → (2) gw management plan

- priority order countermeasures
 - ground raise
 - soil improvement
 - surface water
 - subsurface drainage
- drainage standard (civil & green)

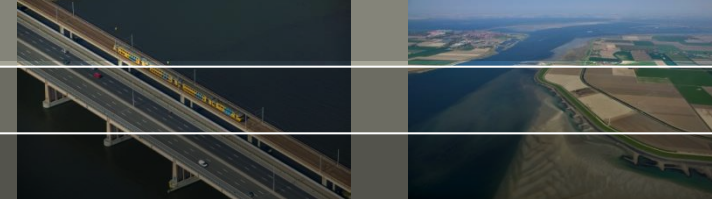




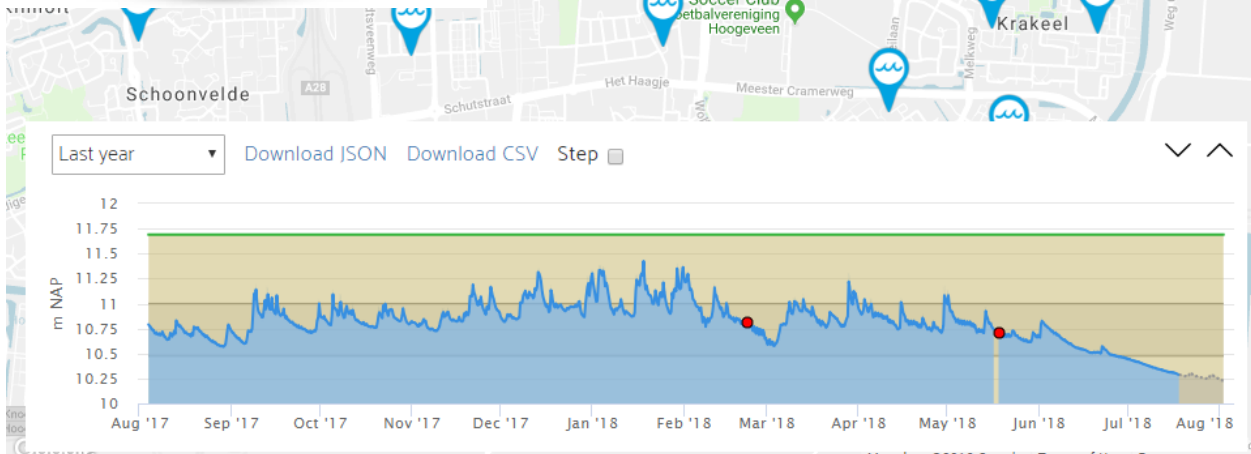
Legislation 2008 → (3) Finance / Institutional

- Gw management is included in the financing & tax structure for municipal sewage works
- Dedicated staff officer(s) (sewage + groundwater)
- Small municipalities: shared officer

signature case study



Legislation 2008 → (4) communication strategy



Hoogeveen, KF42G Telemetrie

GEMEENTE HOOGEVEEN

Grondwaterstand Gemeente Hoogeveen

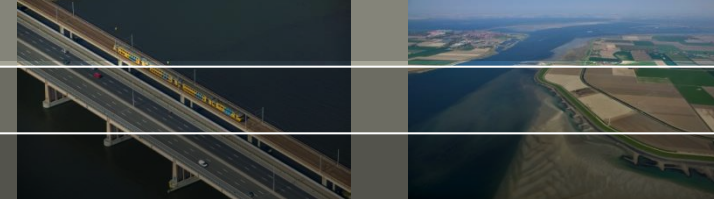
Legenda

- Meetpunten grondwatermeetnet

Grafiek

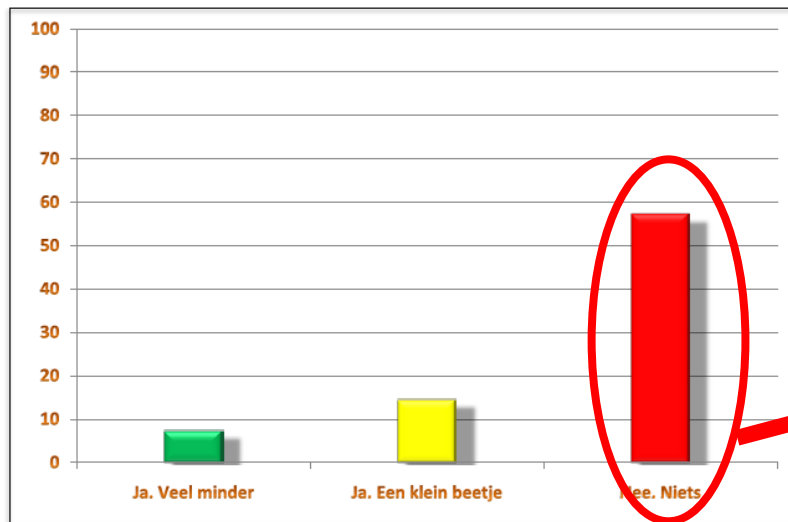
- Maaiveld
- Grondwaterstand

signature case study



Questionnaire: effect of drainage installed in public space

1. U hebt permanent water onder uw woning (kruipruimte).
Is dit minder geworden door aanleg van drainage? (21% v/d inzenders)

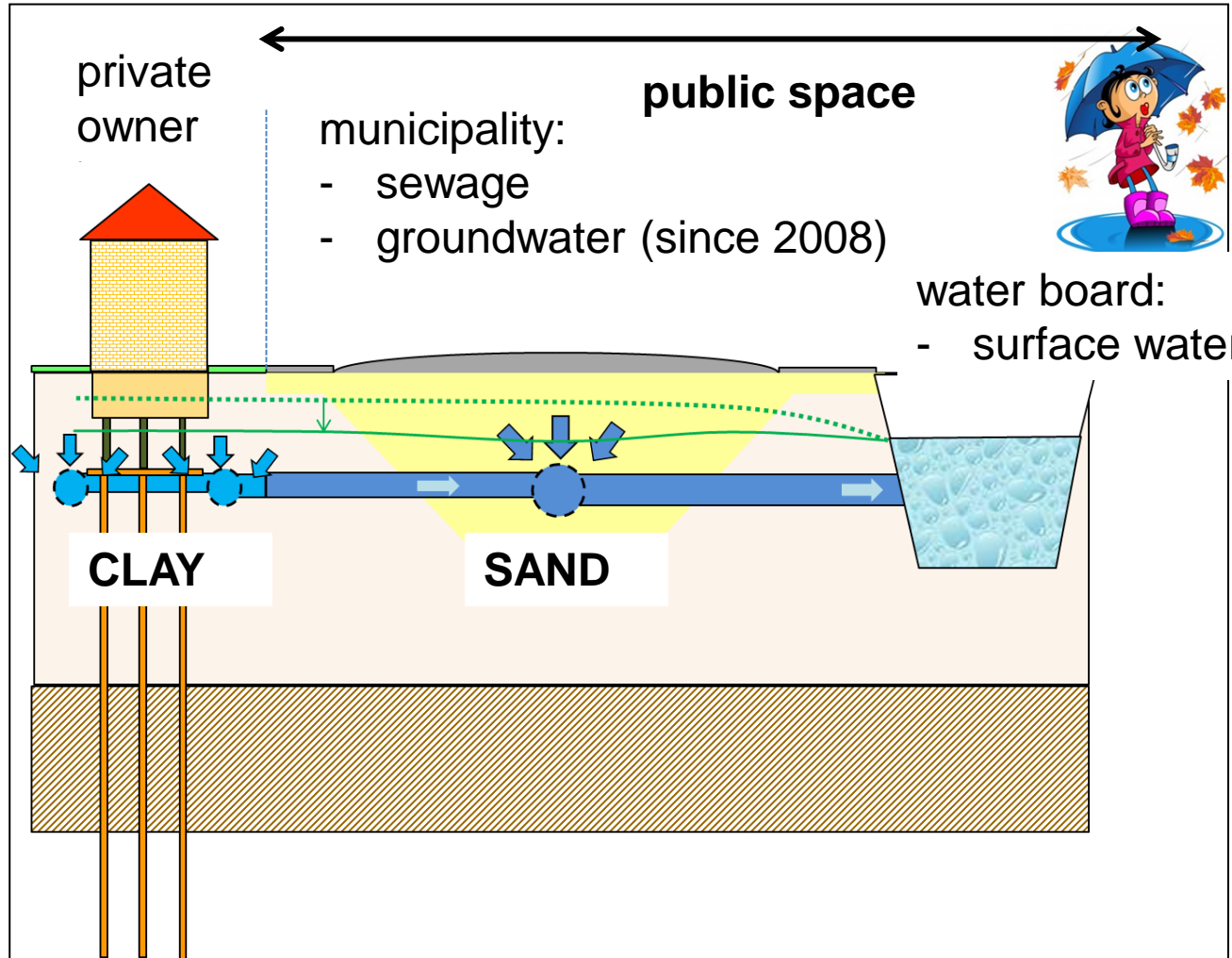
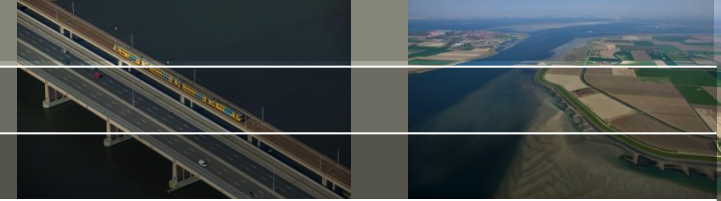


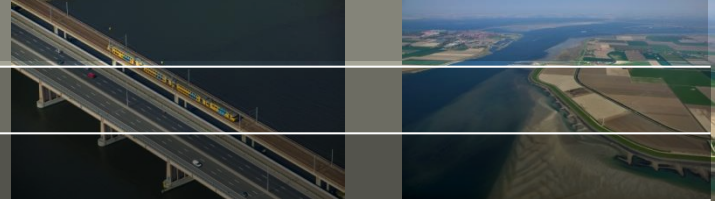
Gemeente Hoogeveen

- no effect on private property (loam)
- shared responsibility

#transparency
#communication

signature case study

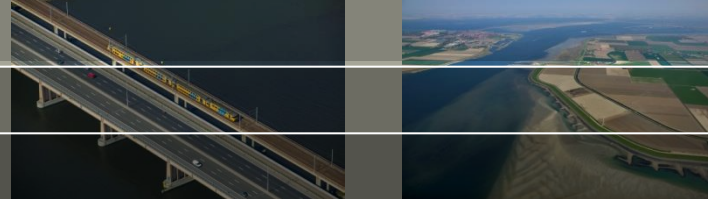




Observations:

- say what you'll do (and not do!)
- do what you said you would
- show that you do what you said you would
- explain: gw management is a shared responsibility
- #transparency

more case studies



Drainage in general:

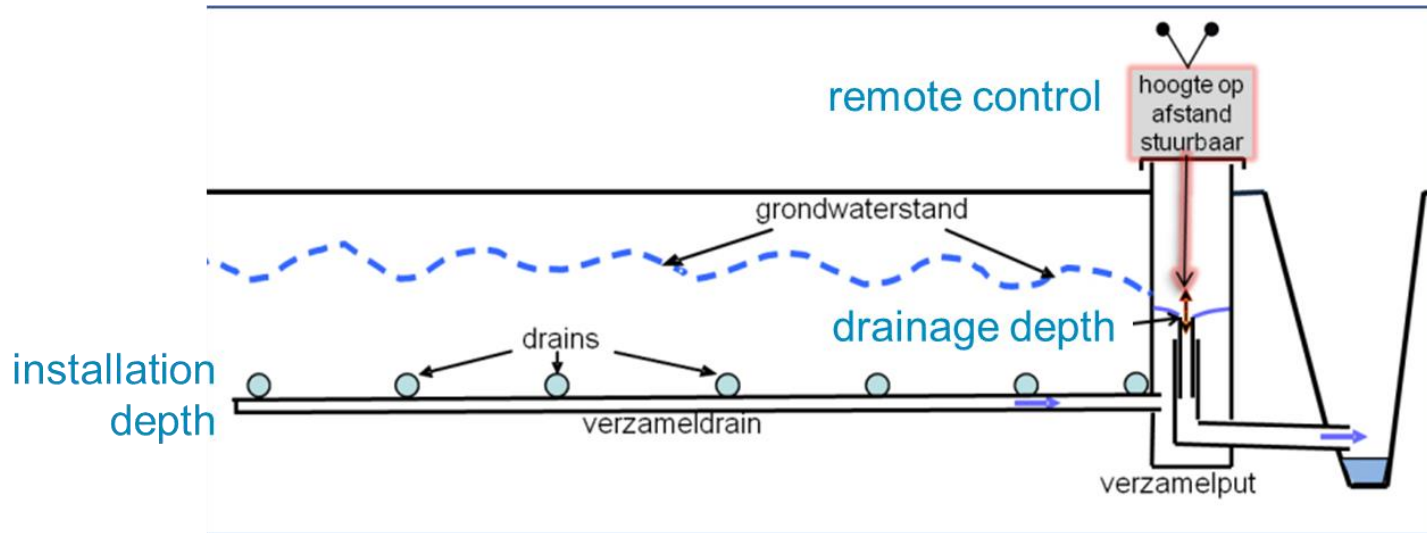
- Install below lowest groundwater !
- Drainage depth \neq installation depth
- Horizontal preferred over vertical drainage



Gemeente Bloemendaal

more case studies

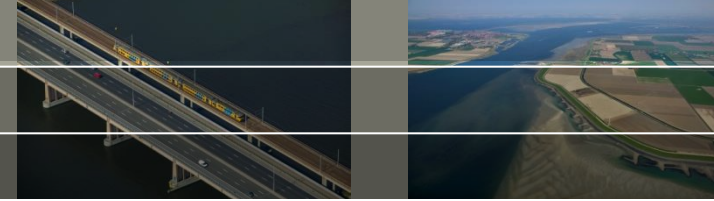
- climate adaptive drainage:
 - against gw flooding, but also against drought (remember summer 2018!)



KlimaatAdaptieve Drainage: innovatief waterbeheer op regionaal en perceelsniveau

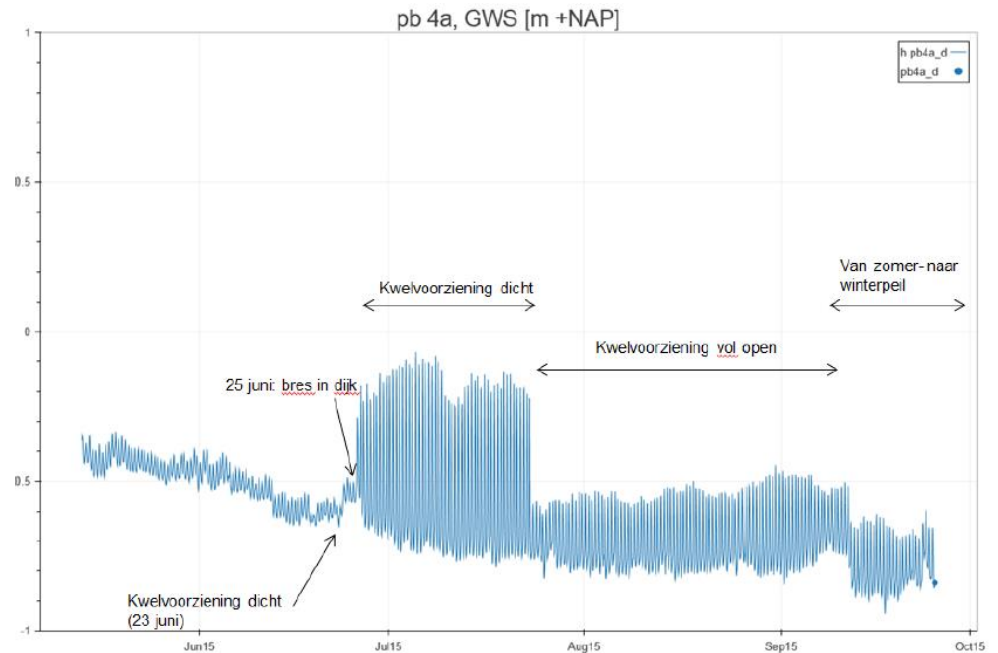
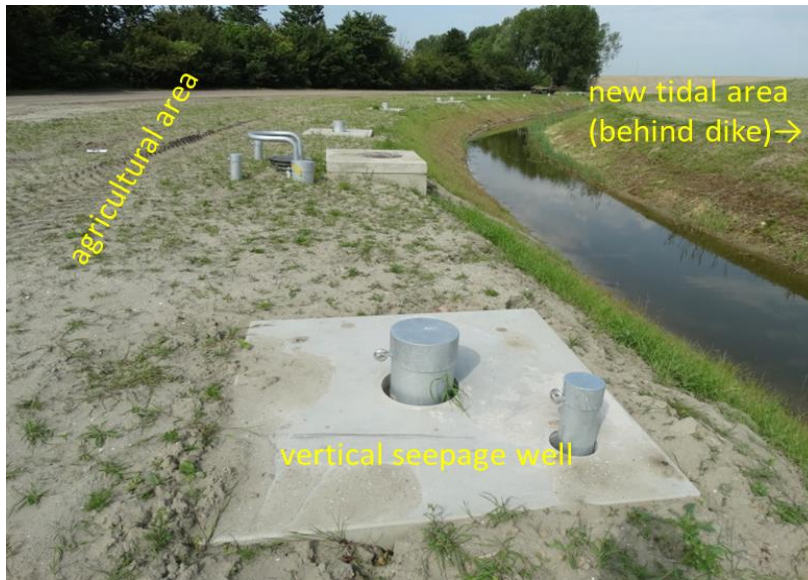
Gé van den Eertwegh (FutureWater), Jan van Bakel (De Bakelse Stroom), Lodewijk Stuyt (Alterra-WUR), Ad van Iersel, Leo Kuipers en Wim Klerk (Kuipers Electronic Engineering), en Michelle Talsma (STOWA)

more case studies



mitigating sea level rise: case Perkpolder

- imposed sea level rise ('depoldering')
- vertical drainage to control deep groundwater rise
- adaptive measure



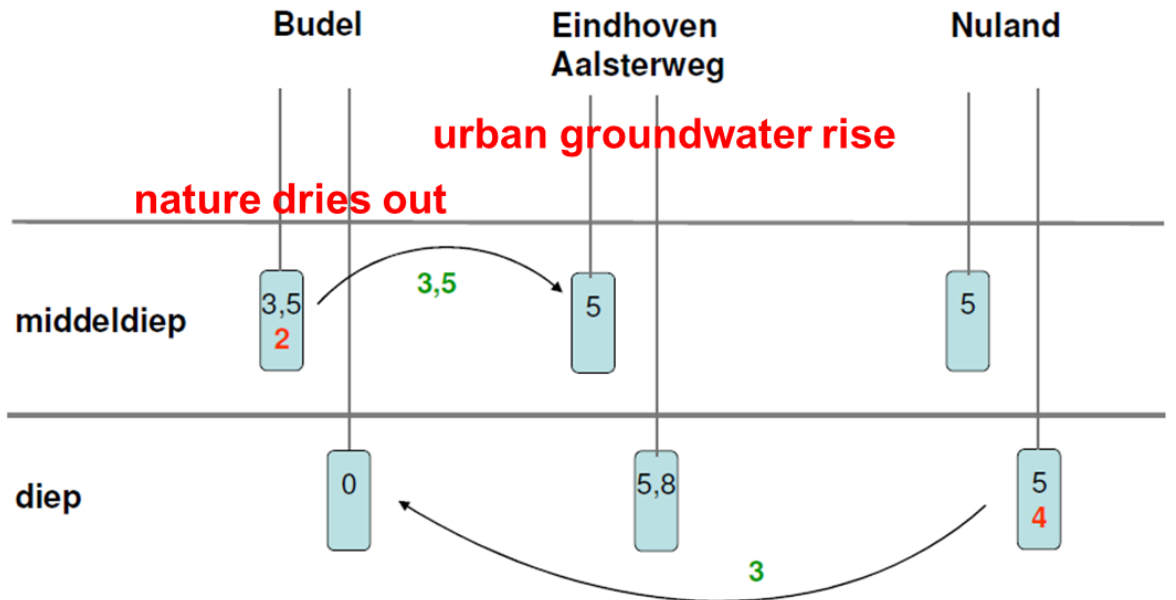
windows of opportunity (1)

governance & closure of gw abstractions:

- reconfiguration abstraction schemes
- Eindhoven: win-win water company, municipality



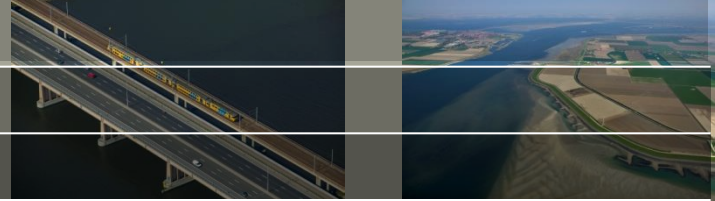
Optimalisatie waterwinningen
Budel, Eindhoven en Nuland
Milieueffectrapportage



5 = permit
5 = actual
5 = future

salt upconing

windows of opportunity (2)



Oosterwolde-Zuid urban redevelopment:

- large-scale renovation of 1960s neighbourhood
- begin-to-end citizen involvement
- new sewers, new surface water, partial demolition, subsurface drainage



urban gw control in NL: conclusions

urban groundwater control:
a shared responsibility (private/public)

say what you'll do (and not do!)
do what you said you would
show that you do what you said you would

drainage: install below lowest groundwater
don't 'overdrain'; remember summer 2018 !

there are windows of opportunity. grab 'em





Thank you for your attention !
jelle.buma@deltares.nl