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Sustainable stormwater management in Oslo

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November 8th 2023, C40 UFN Webinar


Protected forest
300 sq. km
Development zone
150 sq. km

Stormwater management in Oslo Municipality

What are our main challenges?

What legal framework do we have as a municipality to adapt?

How do we achieve the necessary results?

Challenges

- Degradation of vegetation: loss of permeable surfaces, biodiversity and carbon storage
- Damage: High peak runoff (speed and volume) causes damage from erosion, washout and flooding
- Pollution: More frequent extreme events drag particles and pollution out to the rivers and fjord and create more overflow events from sewage systems

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Foto: Nyebilder

Challenges

- **Damage: High peak runoff (speed and volume) causes damage from erosion, washout and flooding**
- **Pollution: More frequent extreme events drag particles and pollution out to the rivers and fjord and create more overflow events from sewage systems**
- **Degradation of vegetation: loss of permeable surfaces, biodiversity and carbon storage**

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Legal framework

Laws, strategies and guidelines in Norway and Oslo Municipality

National laws and guidelines

The Planning and Building Act
The Planning and Building Act provides a broad framework for regulation of planning and building activities in Norway

Technical Regulations (TEK 17)

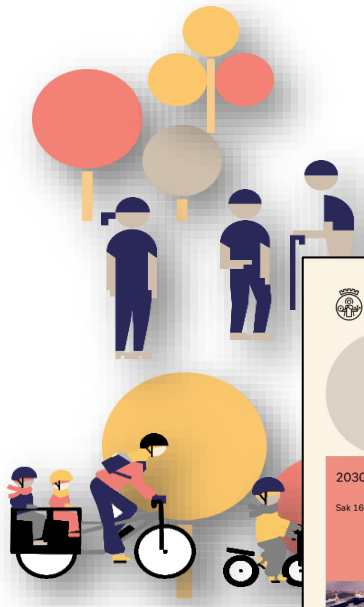
Regulations with technical requirements for design and construction works on a building site

State planning guidelines

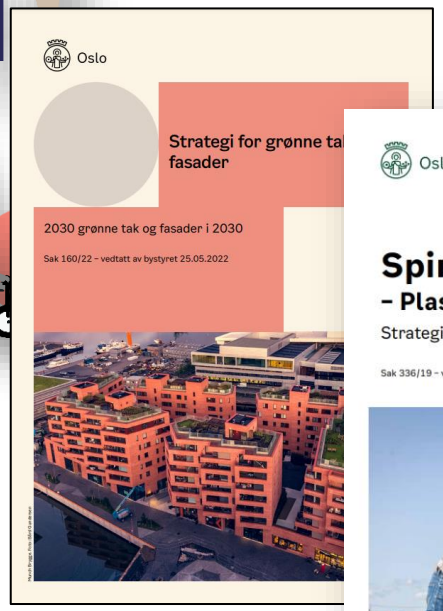
for also climate mitigation and adaptation in planning processes

The Municipal Masterplan
for Oslo Municipality
incl. adaptation and stormwater issues

- **Managing stormwater**
- **Protection against flood risks**
- Extended limits to new buildings along the waterways
- Protection of green spaces
- Re-use of building land, seeking land-neutrality
- Protecting trees
- Protecting farmland and forests etc.

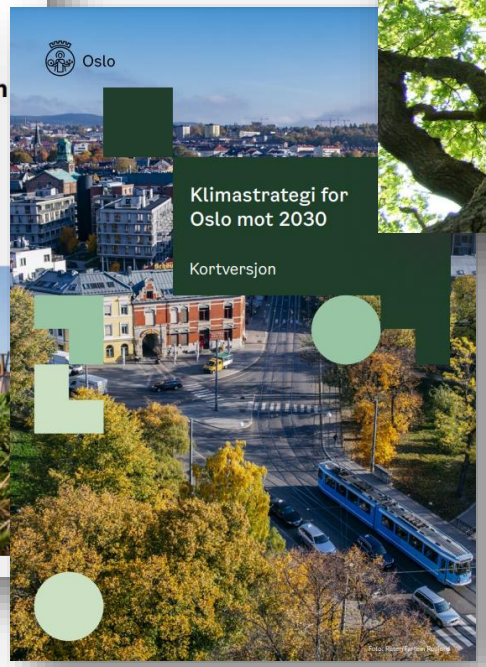


Public health



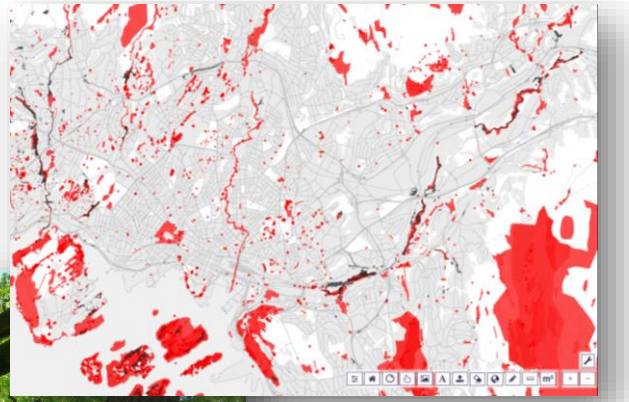
Green roofs and facades

Urban agriculture



Climate strategy

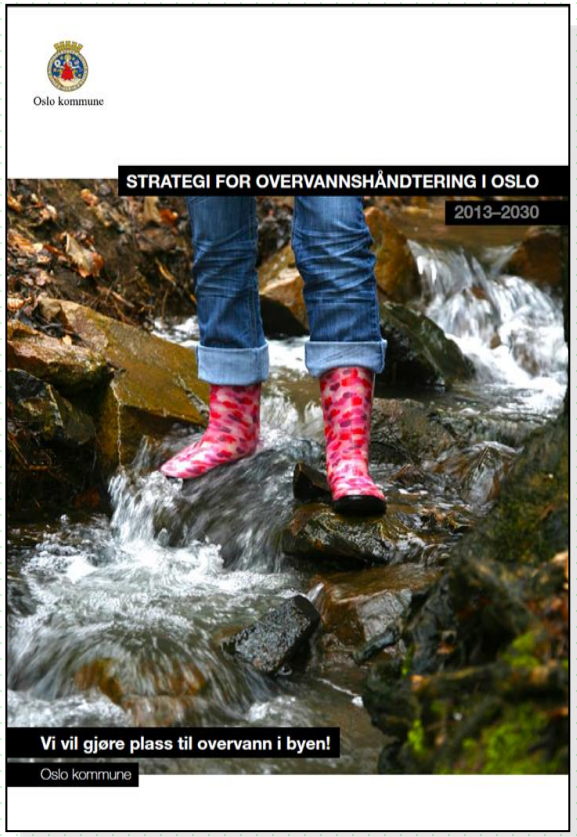
Tree planting



Biodiversity

Strategy for Stormwater Management in Oslo

Approved by City Council in 2014



Strategy Goals:

1. Meeting climate challenges and reducing damage and inconvenience to people, buildings, property and infrastructure

2. Safeguard the environment and ensures good ecological and chemical quality in all water bodies

3. Using stormwater as a resource in the urban environment

Action Plan for Stormwater Management

Approved in City Council in 2019.

18 actions in 5 categories:

1. **Knowledge**
2. **Flooding**
3. **Oslo city setting good examples**
4. **Cooperation**
5. **Information and guidance**

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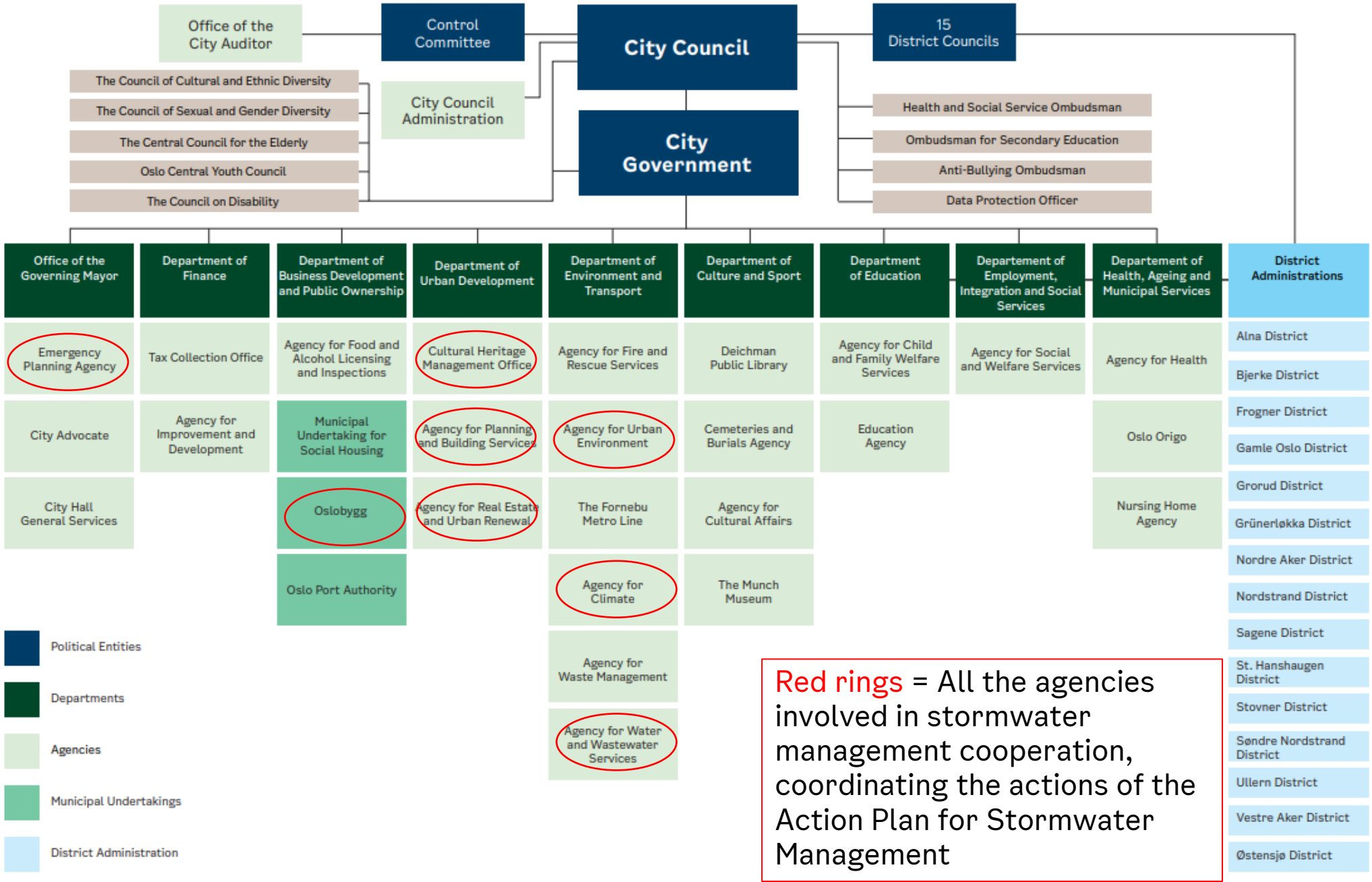
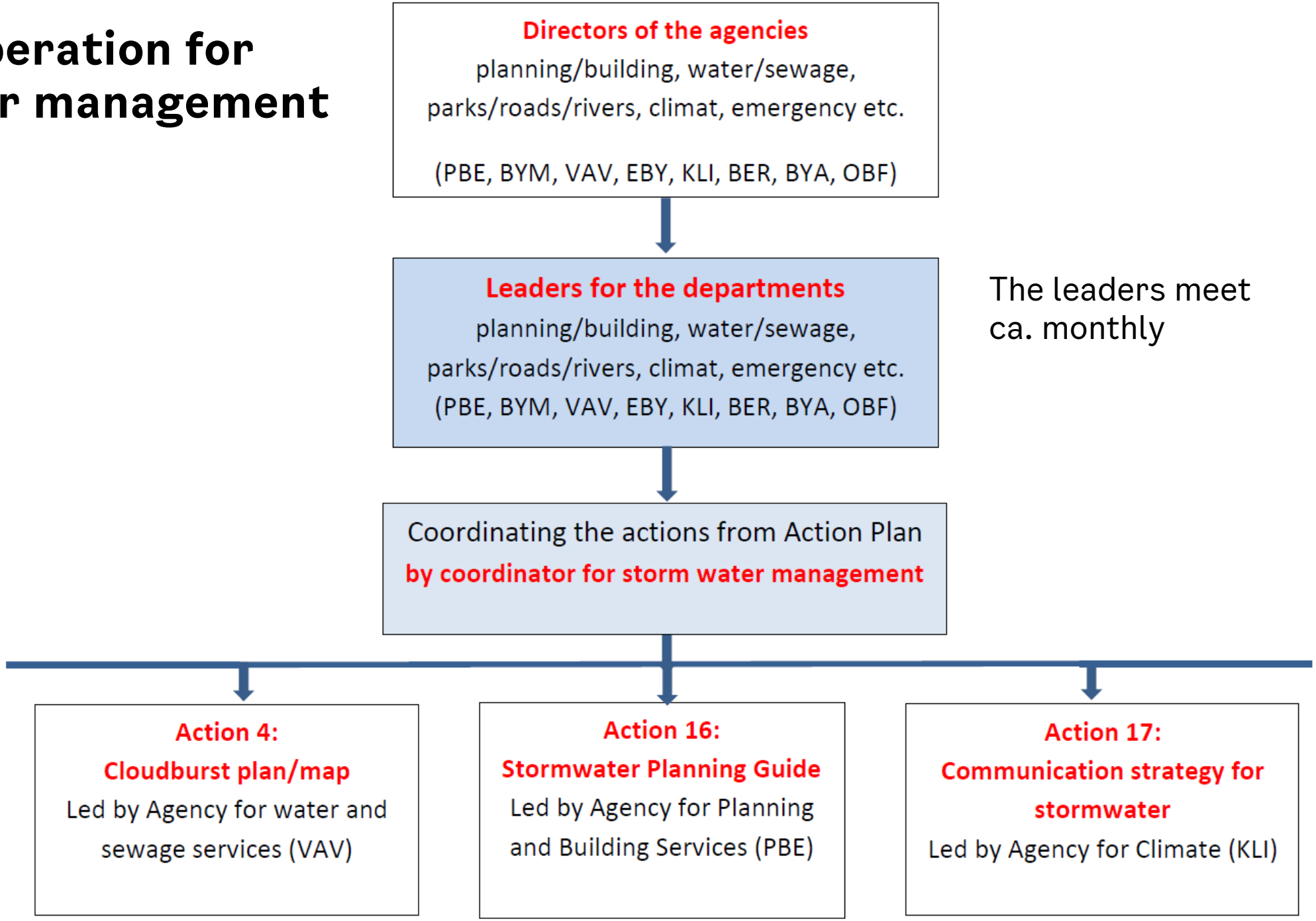
Organizational Chart City of Oslo



Red rings = All the agencies involved in stormwater management cooperation, coordinating the actions of the Action Plan for Stormwater Management

Oslo's cooperation for stormwater management



The leaders meet ca. monthly

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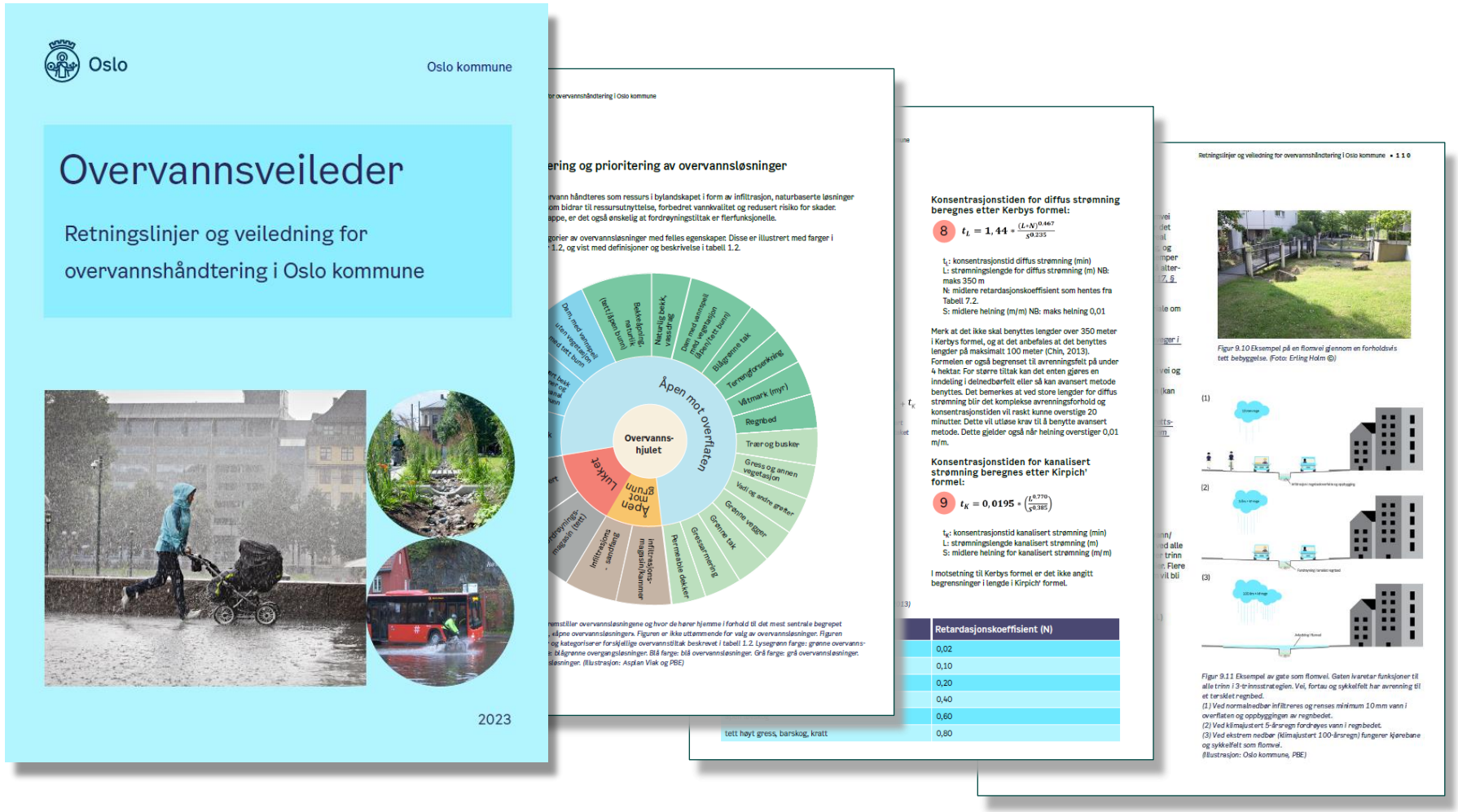
Achieving results? The Stormwater Guidebook

Comprehensive guidelines and requirements for stormwater management

The Stormwater Guidebook

"Requirements and Guidance for Stormwater Management in the City of Oslo"
Published September 2023



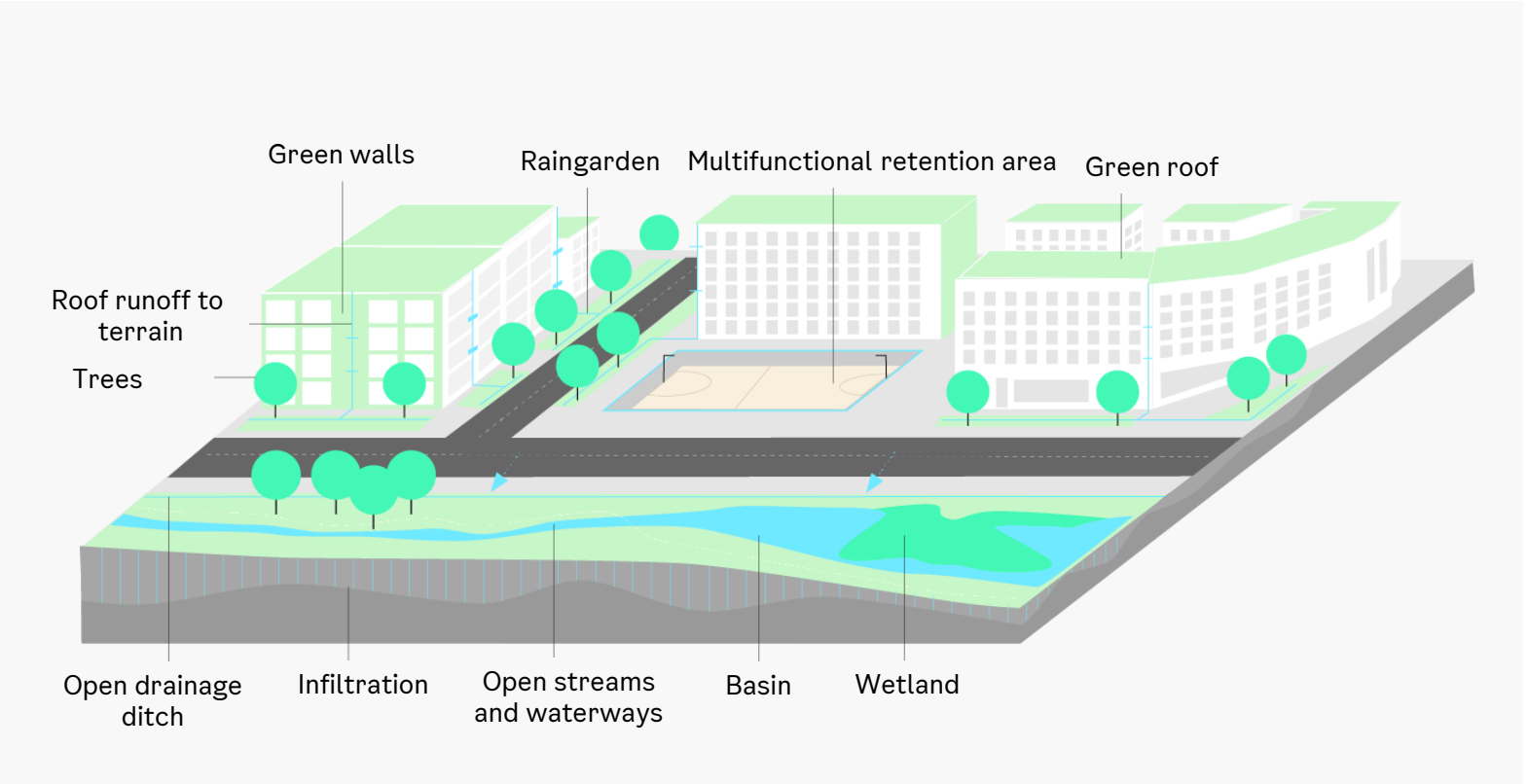
The Stormwater Guidebook

Traditional management of stormwater and waterways

Sustainable and climate-adapted management of stormwater and waterways

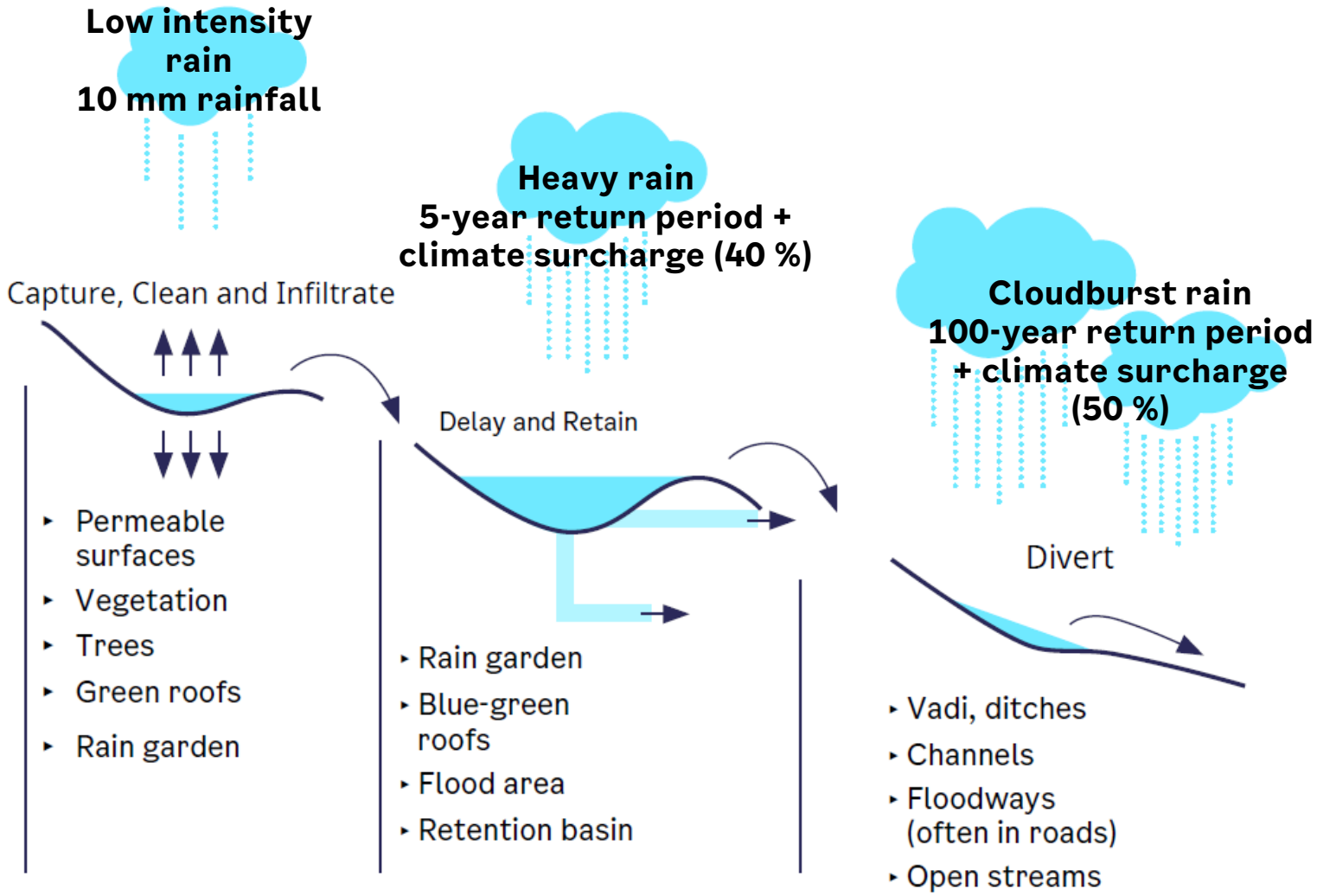
The guidebook includes:

- Detailed framework for management solutions (laws, guidelines etc.)
- Defines physical parameters that effect stormwater management, including city infrastructure and pollution
- Defines dimensioning and design criteria including future rainfall(**the 3-step approach**)
- Recommended application
- Solution catalogue

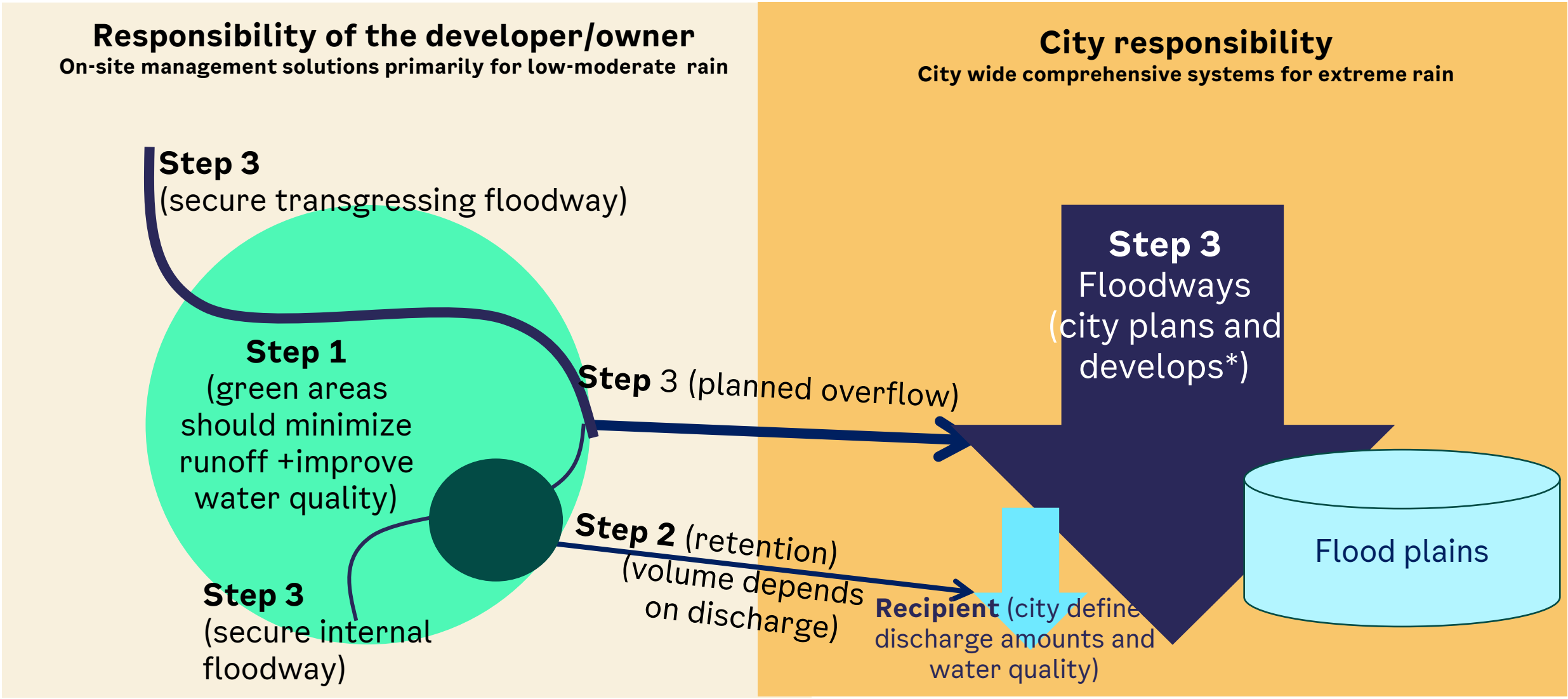


The 3-step stormwater approach Oslo's dimensioning criteria

The 3-step approach strives to recreate the water cycle in a natural catchment by implementing nature based solutions for infiltration (step 1) retention (step 2) and safe flood paths (step 3).



Stormwater management: Who's responsible for the water?



*possibly the developer where appropriate

A «stormwater management plan» must be delivered when planning a housing area

Step 1 (infiltration)
Light green = vegetation
Yellow=extensive sedum roofs
Dark green = raingarden

Step 2 (retention)
Dark green = raingarden

Step 3 (floodway)
Blue arrows, runoff direction

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Step 1
Infiltration 10 mm

Step 1

Requirements should:

- Facilitate ecosystem services and multi-use blue-green areas
- Contribute to a natural water balance, including appropriate groundwater levels
- Improve and/or protect water quality in watercourses
- Reduce the amount of clean stormwater that reaches wastewater treatment plants
- Reduce drinking water consumption and associated energy use through rainwater reuse

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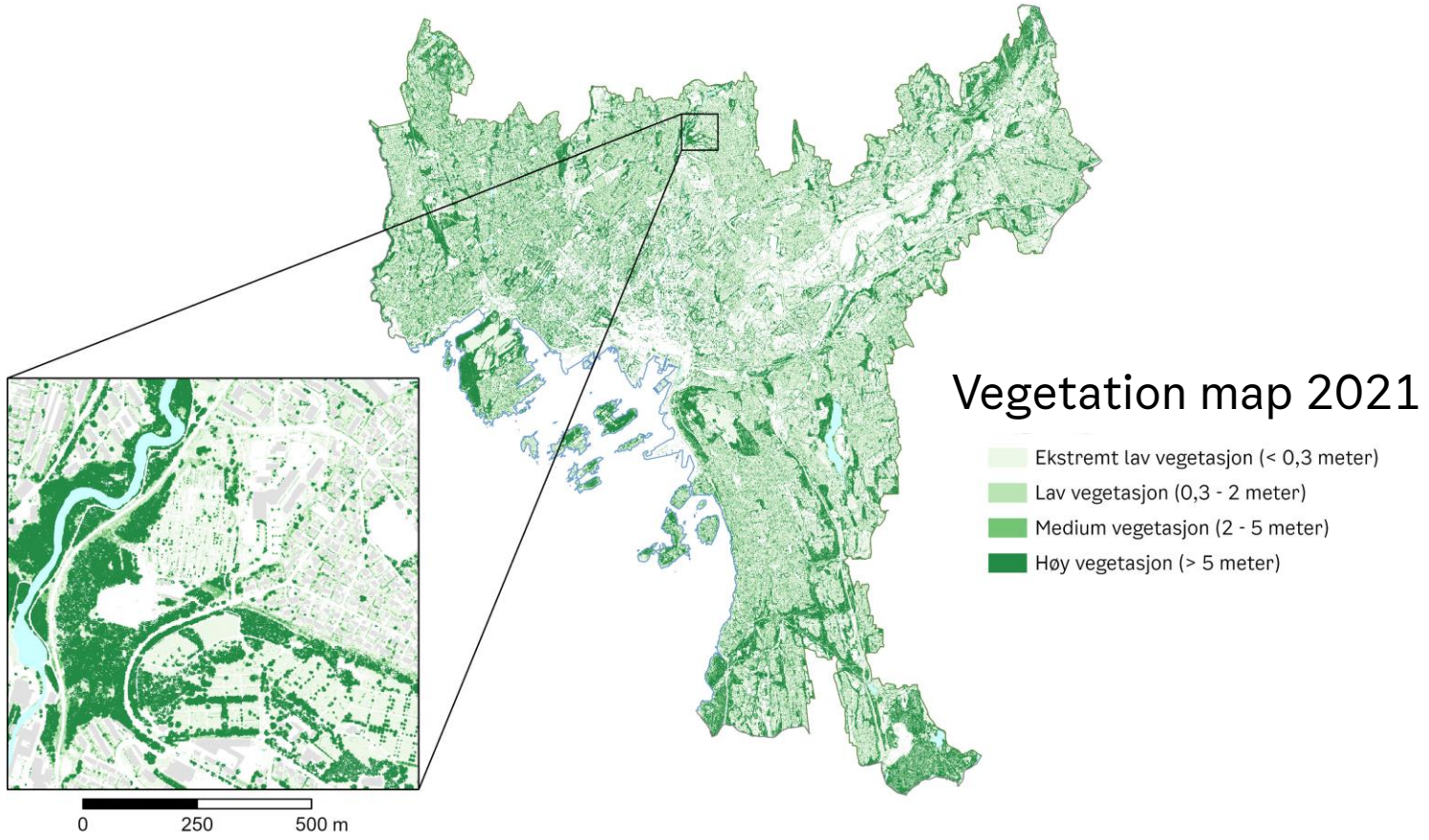
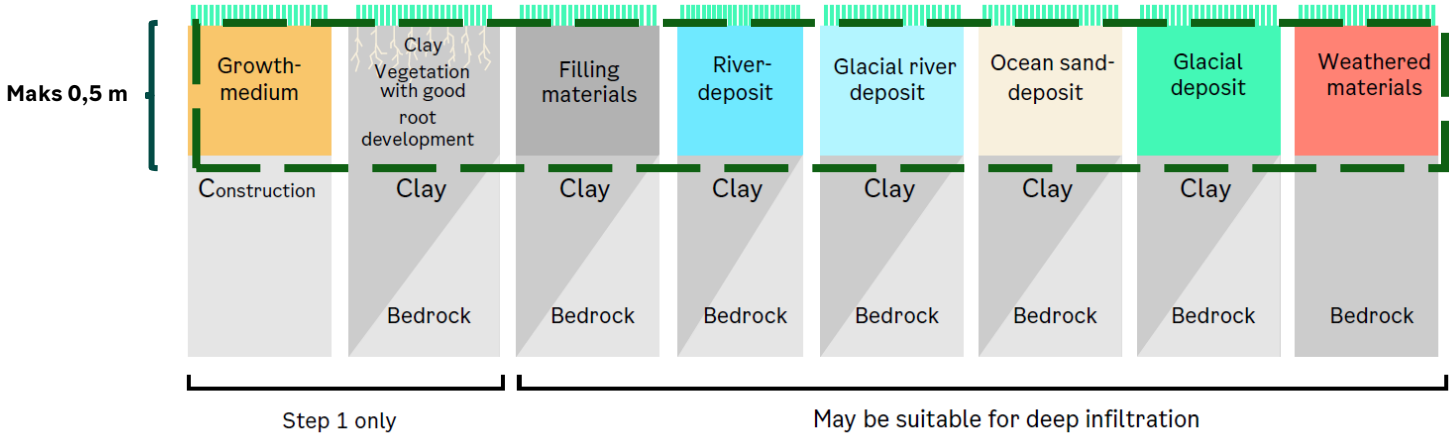


Step 1 Requirements Infiltration

- Step 1: *the runoff from the building site in the event of a 10 mm rainfall must infiltrate into a permeable surfaces and have sufficient space in underlying soil ("shallow infiltration").*
- A quantity requirement: minimum proportion of permeable surfaces
- A feature requirement: runoff from dense surfaces must run into the stretching scope of permeable surfaces
- 10 mm ensures that 95-99% of the annual precipitation has the opportunity to infiltrate and maintains simultaneous runoff from **"first flush"** which contains the majority of pollution.
- "Exemptions" for areas where runoff is collected and reused



Blue Green Index

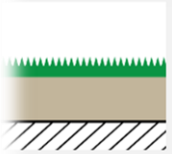
Green space

Dense surface

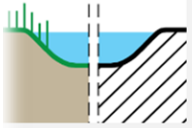
Submerged area and trench

New trees

Existing trees



Green roof



Rain bed, water surface and wetland

Partially open surface

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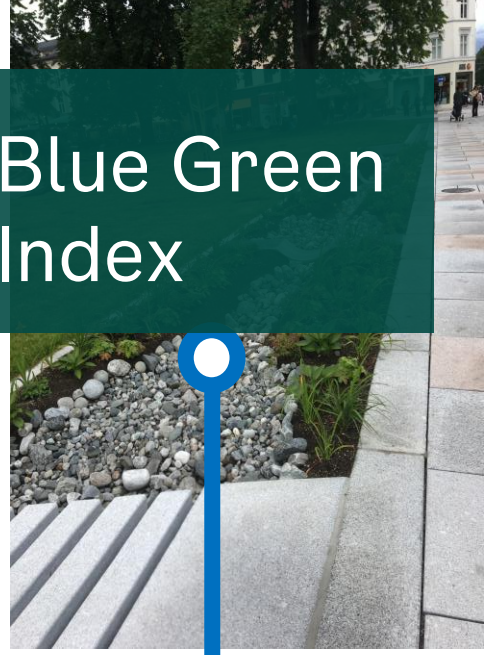
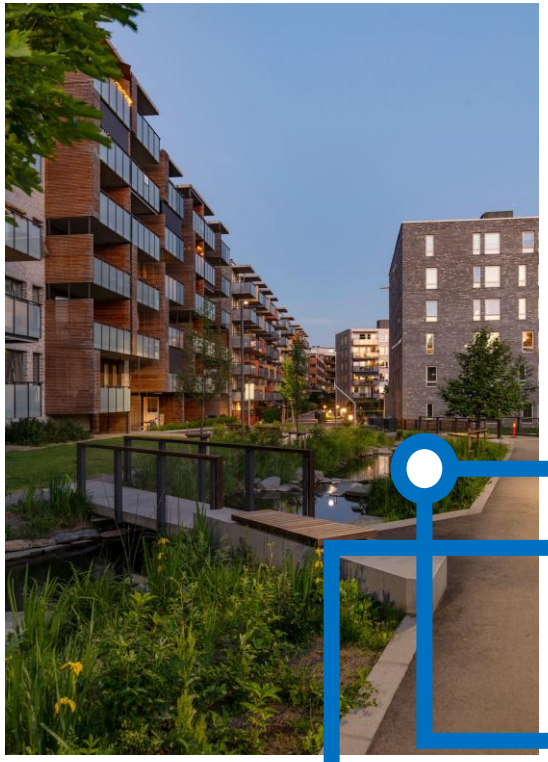
Blue Green

	Geographical location	Blue and green factor
Land use		
Open residentials area (small houses)	City	1,0
Other residentials area (block)	Dense city	0,8
	Open city	0,9
School, kindergarten and health institution	Dense city	0,7
	Open city	0,8
Culture and sport	Dense city	0,6
	Open city	0,8
Office and commercial	Dense city	0,5
	Open city	0,6
Mixed use	Dense city	Main land use
	Open city	Main land use
Industry, storage and logistic	City	0,4
Public space		
Street	Dense city	0,10
	Open city	0,15
Pedestrian street	City	0,3
Square	City	0,4
Green square	City	0,8

Blue Green Index





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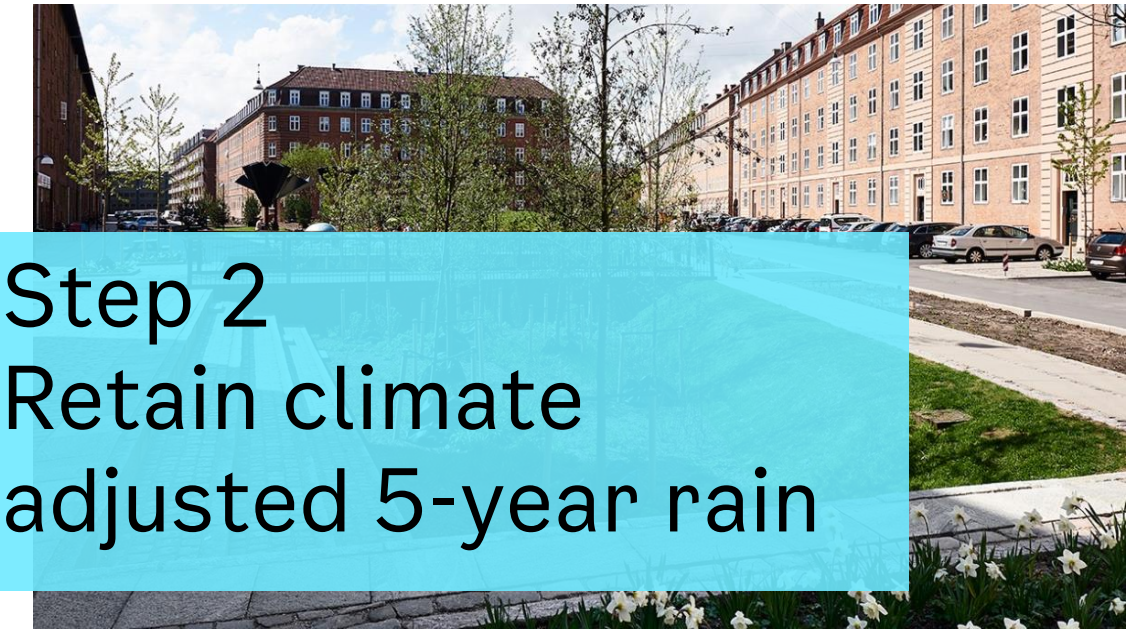
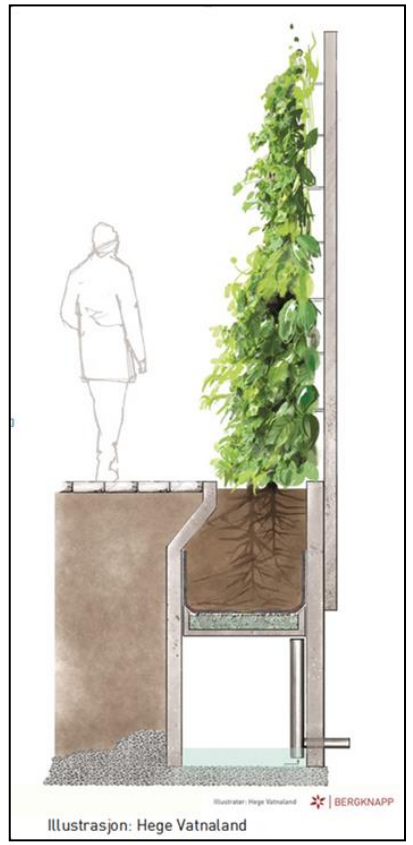
BLÅGRØNN FAKTOR OSLO

Prosjekttittel	Gateadresse	Tomteareal m²	Dato		
Fyll inn	Fyll inn	0	Dag	Måned	År
Tiltak	**Beskrivelse**				
STYRKET BLÅGRØNN STRUKTUR OG BIOLOGISK MANGFOLD			Stykk	Verdi pr stk	
Blågrønn struktur	Fysisk utvidelse av eksisterende blågrønn struktur		0	0,05	0,00
	Restaurering eller etablering av nye leveområder for biologisk mangfold		0		0,00
	Gjenåpning av lukkede vassdrag (bekker og elver i rør)		0		0,00
	Samordning av tiltak med tilgrensende områder og/eller eiere av nabogrunn		0		0,00
	Oppsamling av overvann for vanning og annen gjenbruk		0		0,00
TERRENG OG FLATER			Areal m²	Verdi pr m²	
Grønt terreng	Eksisterende felt- og busksjikt inntil to meters høyde (urbant landbruk og vegetert mark)		0	**1,4**	0,00
	Nytt felt- og busksjikt inntil to meters høyde (urbant landbruk og vegetert mark)		0	**1,2**	0,00
	Eksisterende bunnsjikt som plen, sedum, mose og lav		0	**1,0**	0,00
	Nytt bunnsjikt som plen, sedum, mose og lav		0	**0,8**	0,00
Grønt tak	Dybde vekstmedium ≥ 80 cm		0	**0,9**	0,00
	Dybde vekstmedium 40–80 cm		0	**0,7**	0,00
	Dybde vekstmedium 10–39 cm		0	**0,5**	0,00
	Dybde vekstmedium 3–9 cm		0	**0,3**	0,00
Grønn vegg	Plantevegg og vertikalt urbant landbruk		0	**0,6**	0,00
	Slyng- og klatreplanter		0	**0,3**	0,00
Regnbed, vannspeil og våtmark	Regnbed er frodige og variert beplantede fordypninger for oppsamling og infiltrering av overvann. Vannspeil (elv, bekk, dam) skal ha bunnsubstrat og kantvegetasjon. Våtmark er fuktig mark som er overflommet eller har vann nær overflaten store deler av året.		0	**3**	0,00
Terreng-forsenkning og vadi	Terrengforsenkning er en fordypning i terreng eller flate, i form av vegetert overflate, lekeplass, torg og lignende, som er opparbeidet for uteopphold, der overvann kan fordrøyes og infiltreres gjennom permeabel overflate. Vadier er grønne grøfter, eventuelt beplantet, og de er velegnet for oppsamling og bortledning av overvann.		0	**1**	0,00
Delvis åpen flate	Permeable grønne overflater (gressarmert dekke)		0	**0,4**	0,00
	Semi-permeabel grå flate (sand, grus, singel, pukk og gjennomhullede faste dekker)		0	**0,3**	0,00
	Delvis permeabel grå flate (gatestein satt i pukk og lignende på permeabel undergrunn)		0	**0,2**	0,00
Tett flate	Tette flater der regnvann ledes til blågrønt tiltak på tomten med infiltrasjons- og fordrøyningskapasitet etter krav til overvannshåndtering (dokumentasjonsbehov) eller til vannoppsamler		0	**0,1**	0,00
TRÆR			Stykk	Verdi pr stk	
Eksister-ende trær	Svært store trær – stammeomkrets over 200 cm		0	**70**	0,00
	Store trær – stammeomkrets 90–200 cm		0	**50**	0,00
	Små trær – stammeomkrets under 90 cm		0	**40**	0,00
Nye trær	Store trær – fremtidig høyde over 10 meter		0	**30**	0,00
	Små trær – fremtidig høyde under 10 meter		0	**20**	0,00
Utarbeidet av Plan- og bygningsetaten. Høringsversjon 06.04.2022				**BLÅGRØNN FAKTOR**	**0,00**

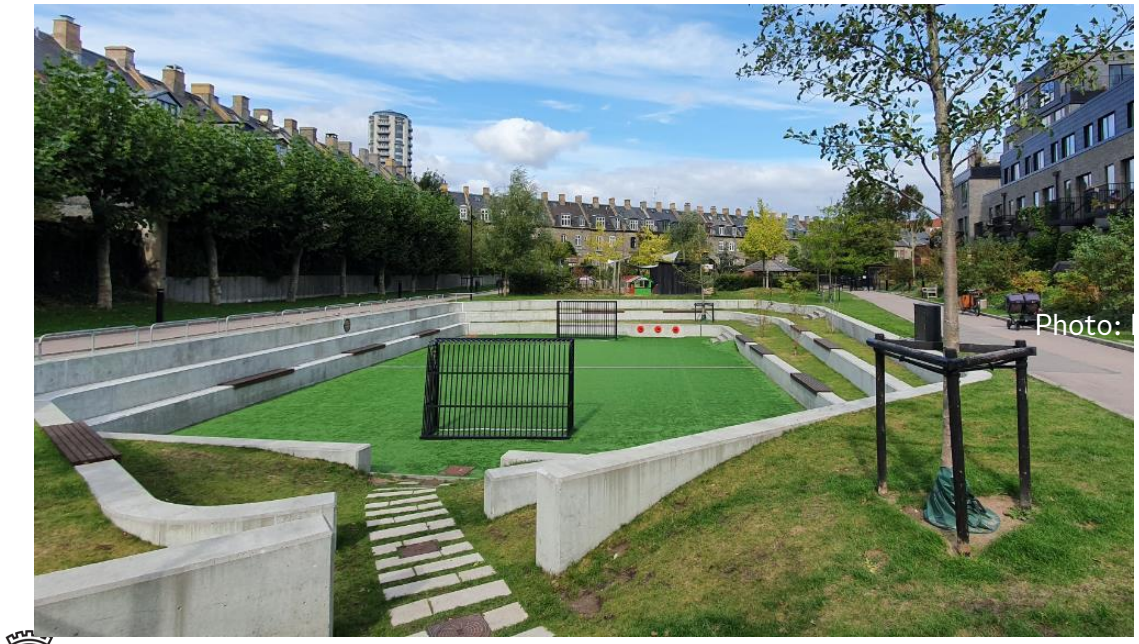
Link to different norms in Oslo, incl. BGF

Step 2
Retain climate adjusted 5-year rain





Illustrasjon: Hege Vatnaland



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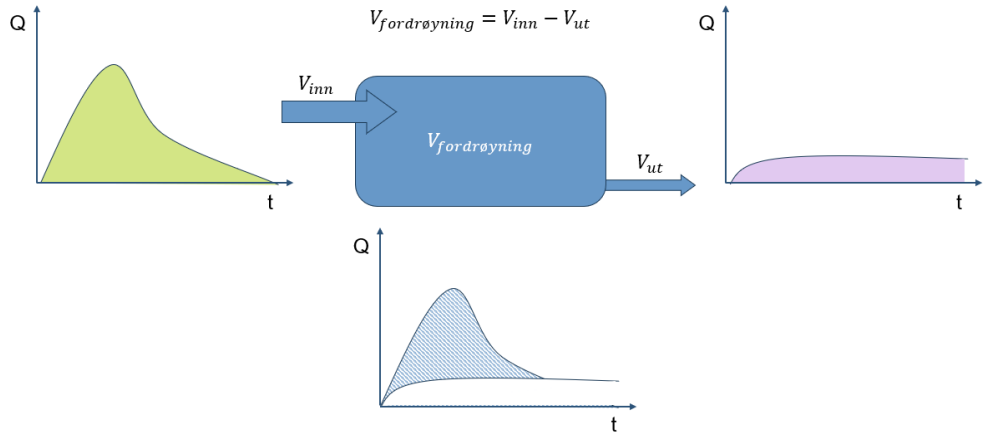
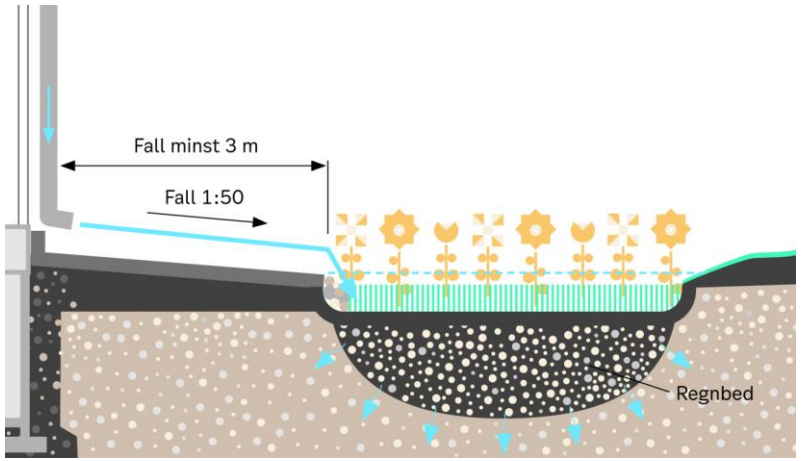
Step 2
Goals/Requirements

- Reduce the risk of stormwater damage and improve land use
- Minimize pollution of watercourses by sedimentation, and reducing overflow from wastewater systems
- Reduce the amount of clean water being sent to wastewater treatment plants, improve the quality of the sewage sludge, and reduce energy costs in the sewage system
- Requirements should stimulate local nature based and/or multifunctional retention solutions
- Requirements must be possible to document so that we know that we are achieving the desired result

Step 2 Design

- Dimensioning criteria have been lowered from a climate adjusted 20-year return period to 5-year, to stimulate for more open land based retention
- Clearer definition of design parameters including runoff coefficients, controlled discharge possibilities (including municipal pipes and surface runoff).
- Clearer definition of infiltration that allows for some infiltration, without it being the only discharge





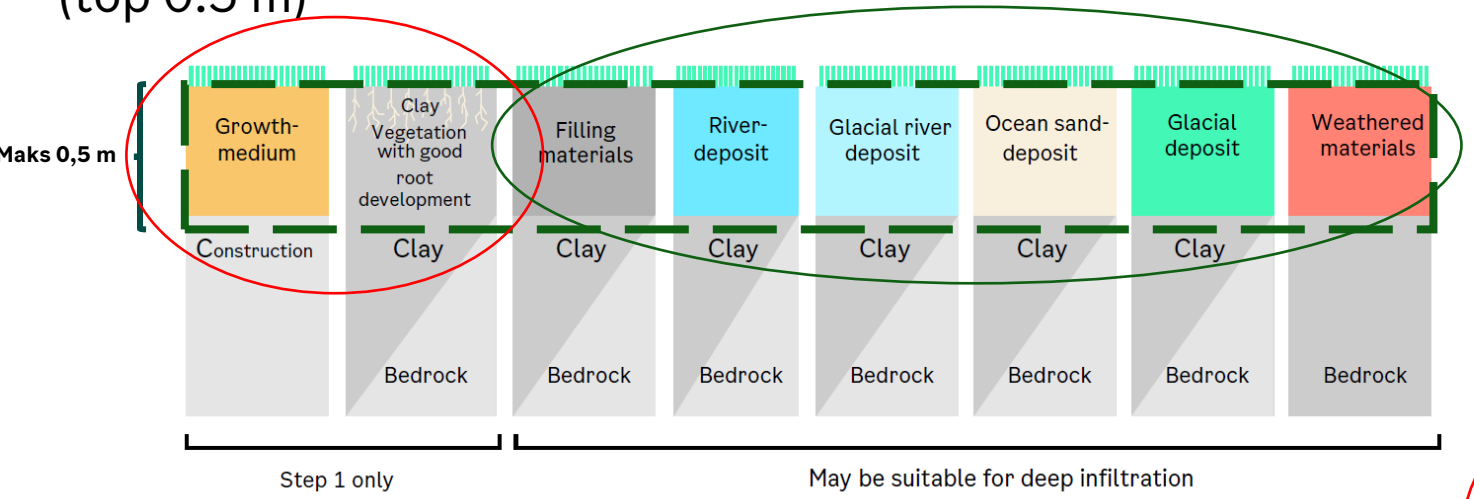
Introducing the term “shallow infiltration” for step 1 and “deep infiltration” for step 2

Why?

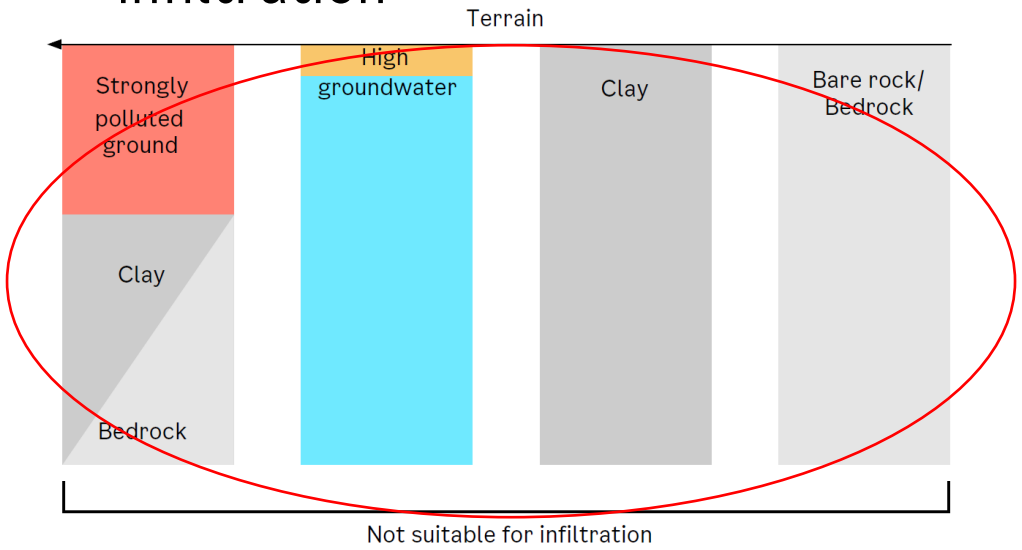
Previously “local management” was interpreted as the infiltration of all water up to a climate adjusted 20-year rainfall. This was almost impossible to document or achieve as Oslo is primarily on marine clay.

Only suitable for “Shallow infiltration" (top 0.5 m)

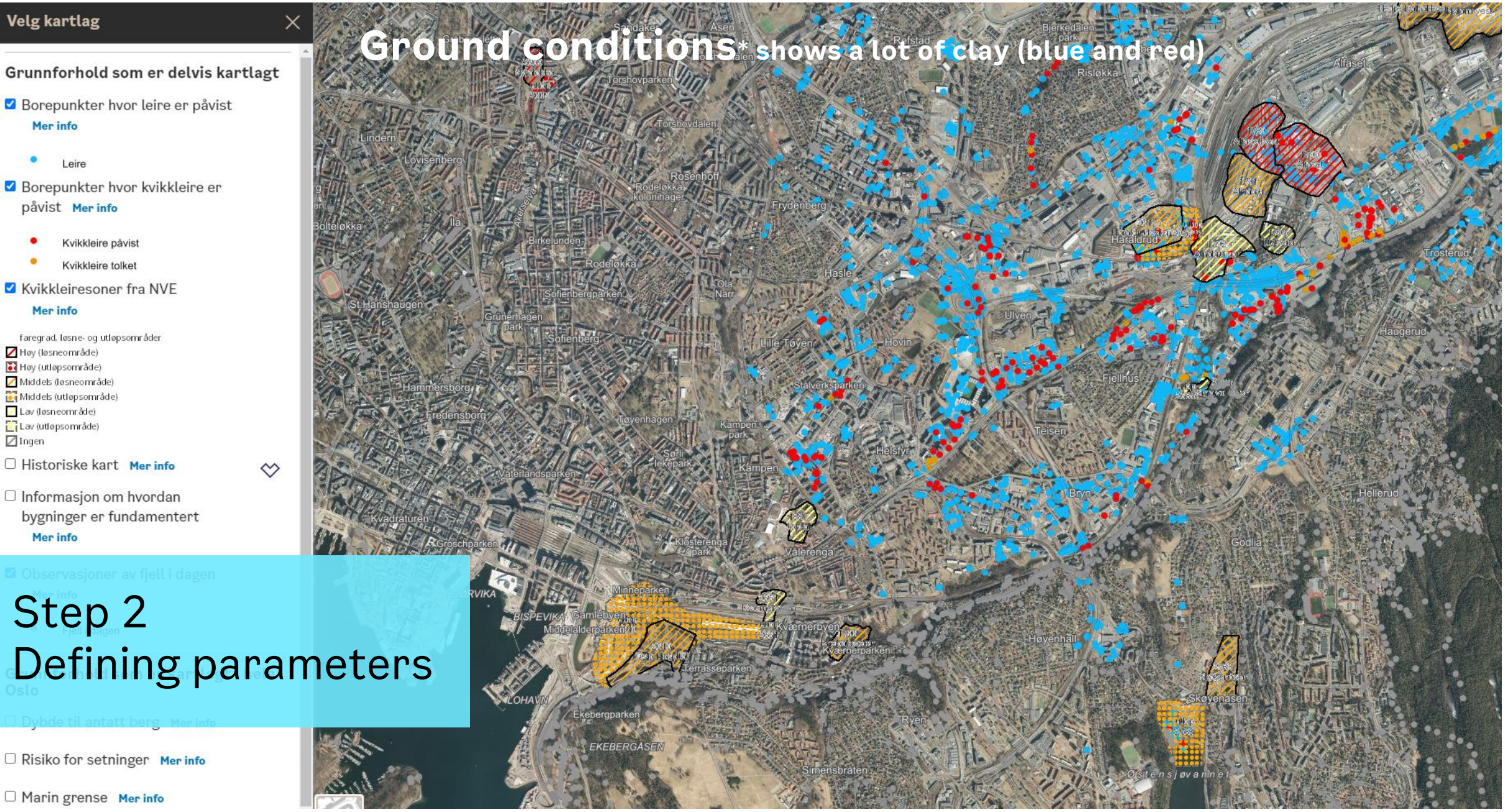
Possibility of deep infiltration



Unsuitable for deep or shallow infiltration



Step 2
Defining parameters


Velg kartlag
Grunnforhold som er delvis kartlagt
Borepunkter hvor leire er påvist
Mer info
Leire
Borepunkter hvor kvikkleire er påvist Mer info
Kvikkleire påvist
Kvikkleire tolket
Kvikkleiresoner fra NVE
Mer info
faregrad, løsne- og utløpsområder
Høy (løsneområde)
Høy (utløpsområde)
Middels (løsneområde)
Middels (utløpsområde)
Lav (løsneområde)
Lav (utløpsområde)
Ingen
Historiske kart Mer info
Informasjon om hvordan bygninger er fundamentert
Mer info
Observasjoner av fjell i dagen
Risiko for setninger Mer info
Marin grense Mer info
Ground conditions* shows a lot of clay (blue and red)
Step 2
Defining parameters

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Step 2
Defining parameters

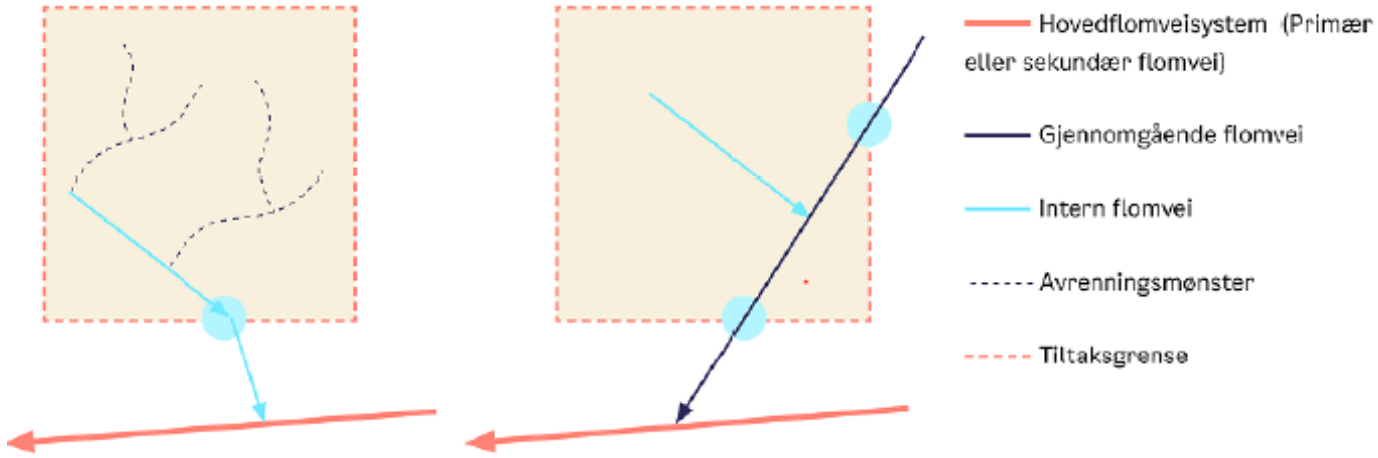
For building sites within 250 m of a river/fjord, retention is not necessary given that water quality is acceptable, and discharge does not lead to erosion or other damage.
Step 1 must still be fulfilled.

Step 3

Secure 100-year climate adjusted rain

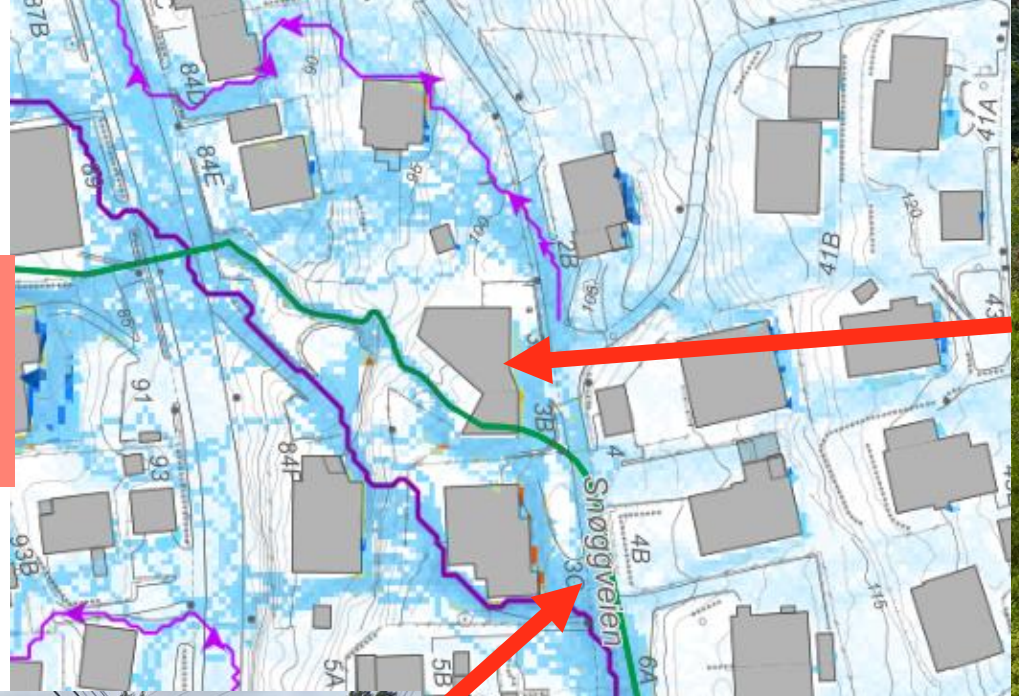
Step 3

Goals/Requirements



- Reduce the risk of damage from stormwater locally and downstream of the building area
- Allocate space for floodways (runoff from the property during a future 100-year rain)
- Entry and outlet points through the building site should not be changed. The floodways must guide water towards the primary floodway system (unless a better solution has been selected and approved by the city).
- Where there is also a floodway traverse the building site, space must be set aside for runoff from upstream as well as on-site runoff

Example


Snøggveien
Snøggveien

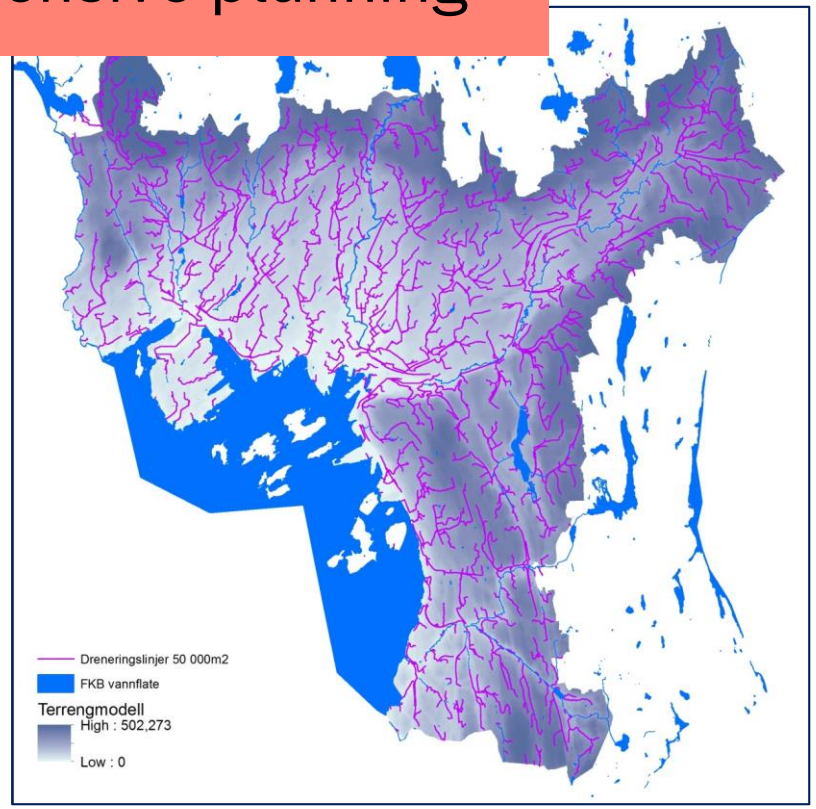

Snøggveien


Snøggveien
Snøggveien

New flood modelling– from runoff-lines to depth and speed

Step 3

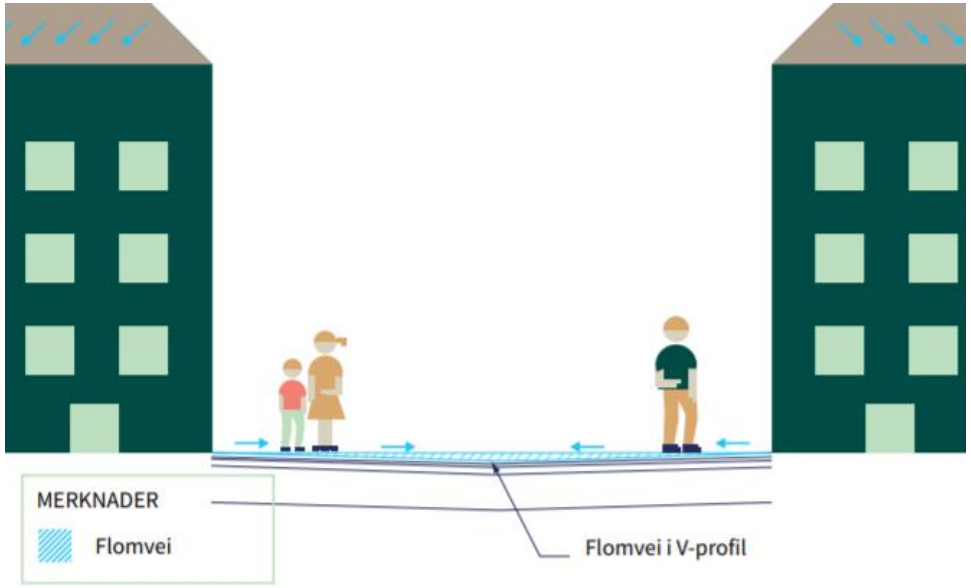
Comprehensive planning

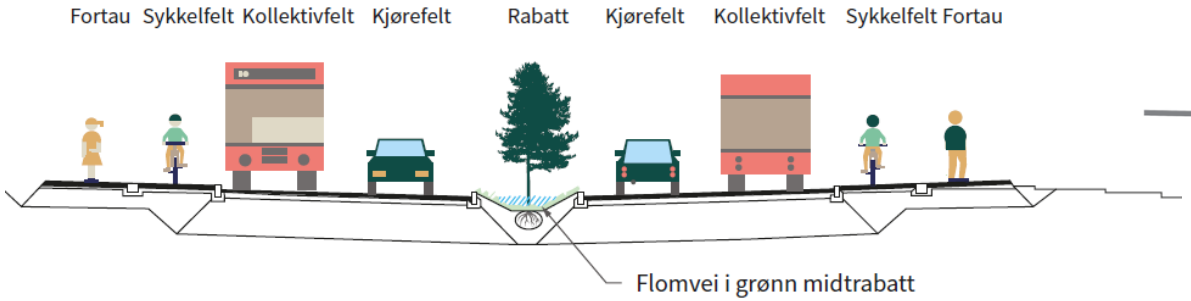


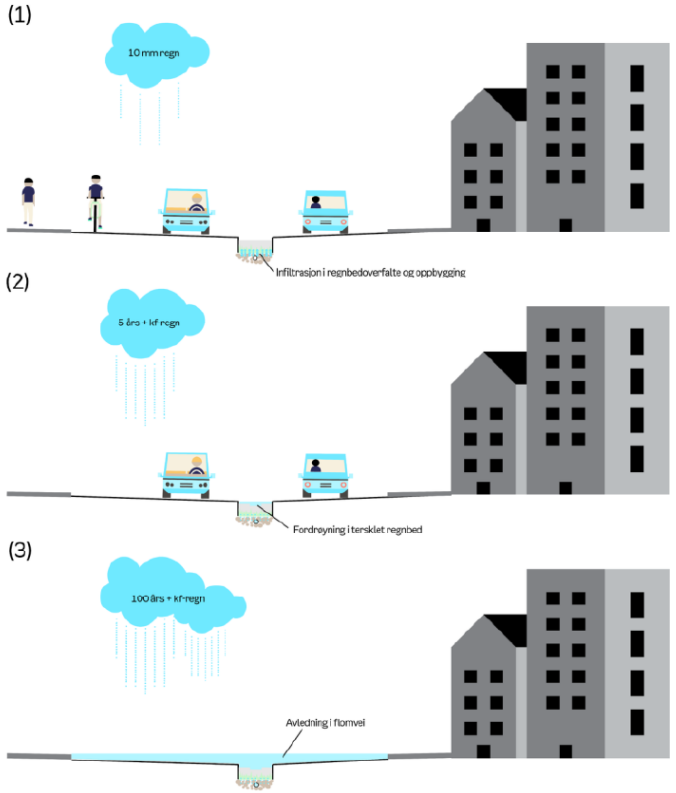
Mike + (Mike Flood)

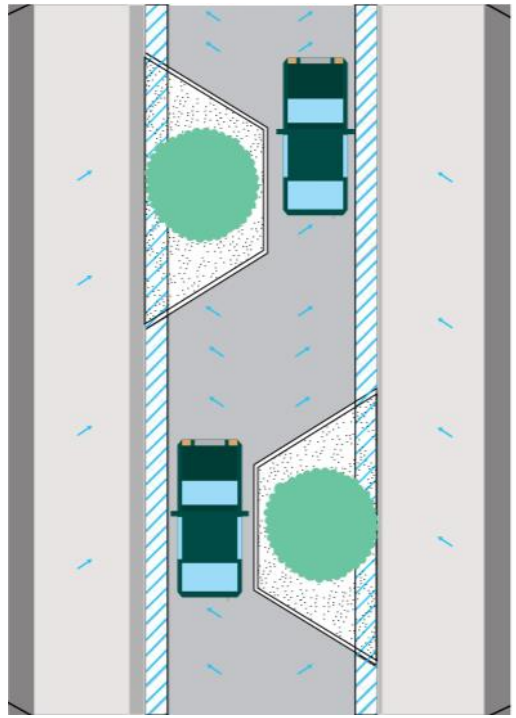
Step 3

Floodway design in roads



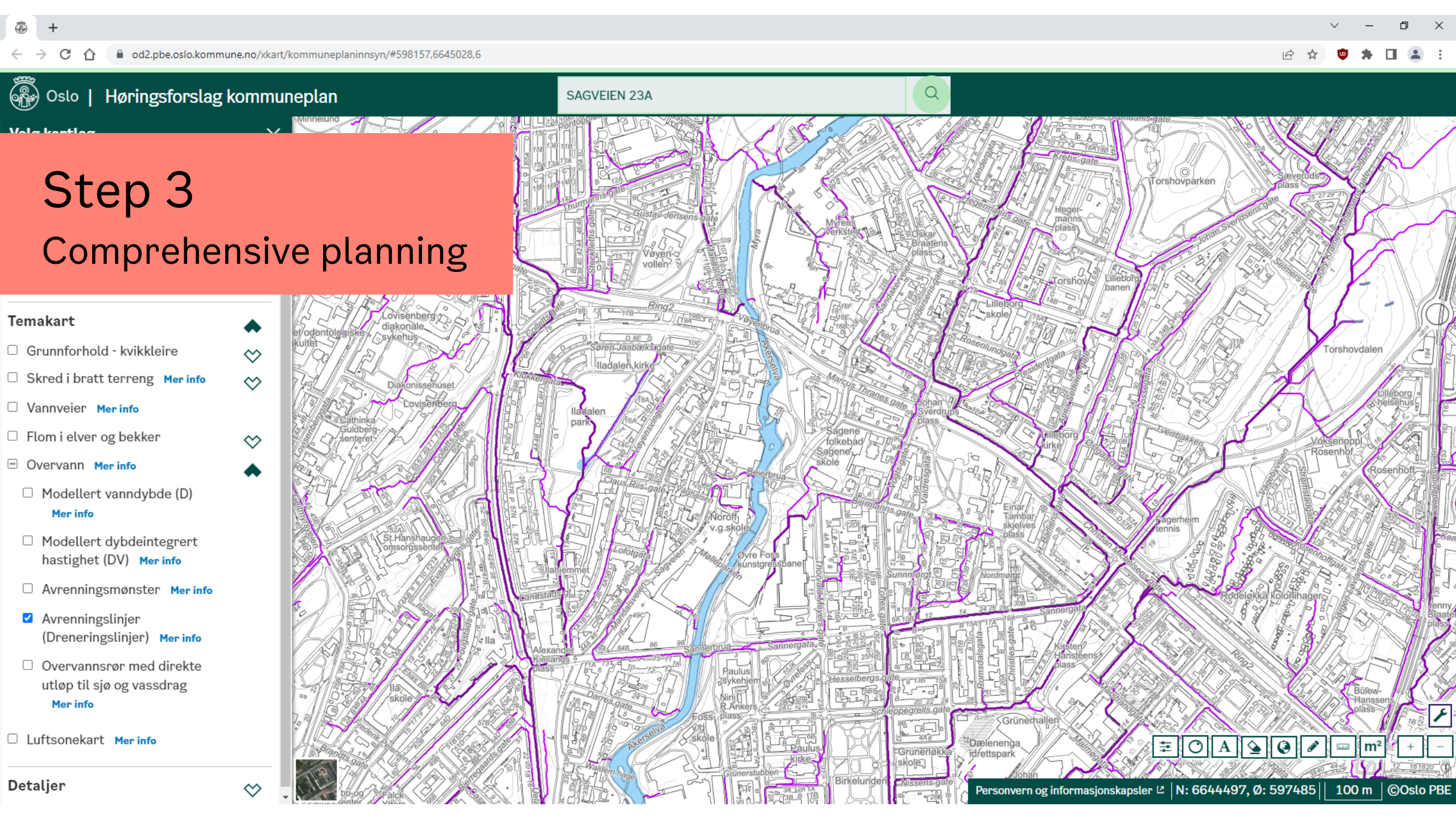






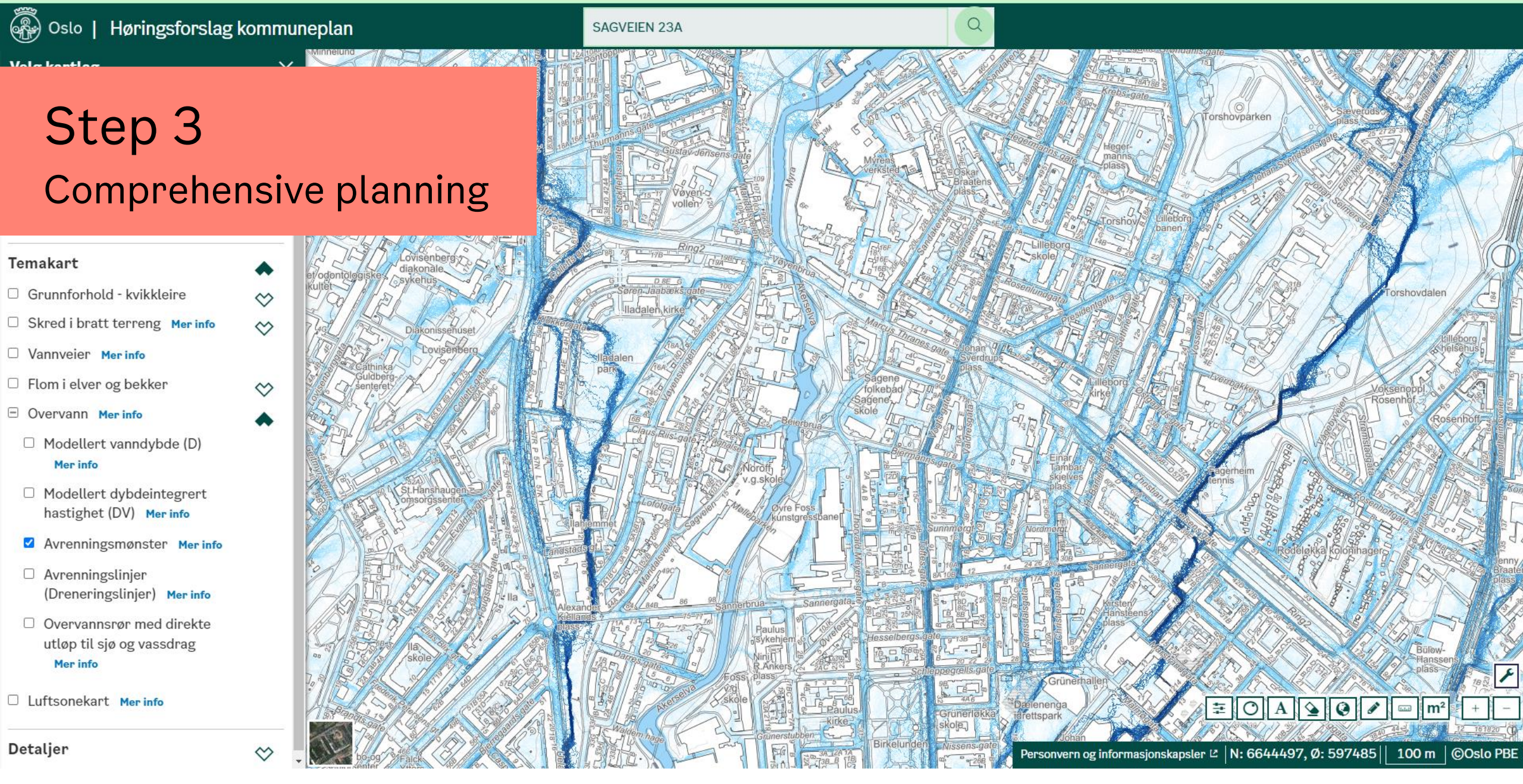
Step 3

Comprehensive planning



Step 3

Comprehensive planning



Achieving our goals: Implications of the new guidebook

Specific requirements for Step 1
More permeable surfaces that hold back precipitation via interception, evapotranspiration and infiltration, dampen flood peaks and water

Down scaled requirements for Step 2 with increased focus on open solutions
Multifunctional outdoor spaces/increased utility, robust solutions that are accessible and that provide increased opportunities for maintenance, adaptation to needs and operational experience

Requirement for Step 3 uphold and secure existing runoff pattern
Diversion of water prevents damage as well as helps maintain natural waterways and runoff patterns

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