

Vancouver's Rain City Strategy: Using Nature Based Solutions to Improve Water Quality

Prepared for:

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Vancouver is a city surrounded by water



Image: Overview of Vancouver's downtown peninsula
Photo Credit: www.fiercebiotech.com 01/25/2017



The water is where we
live, work and play

Our local waters
and even the rain
shape who we are

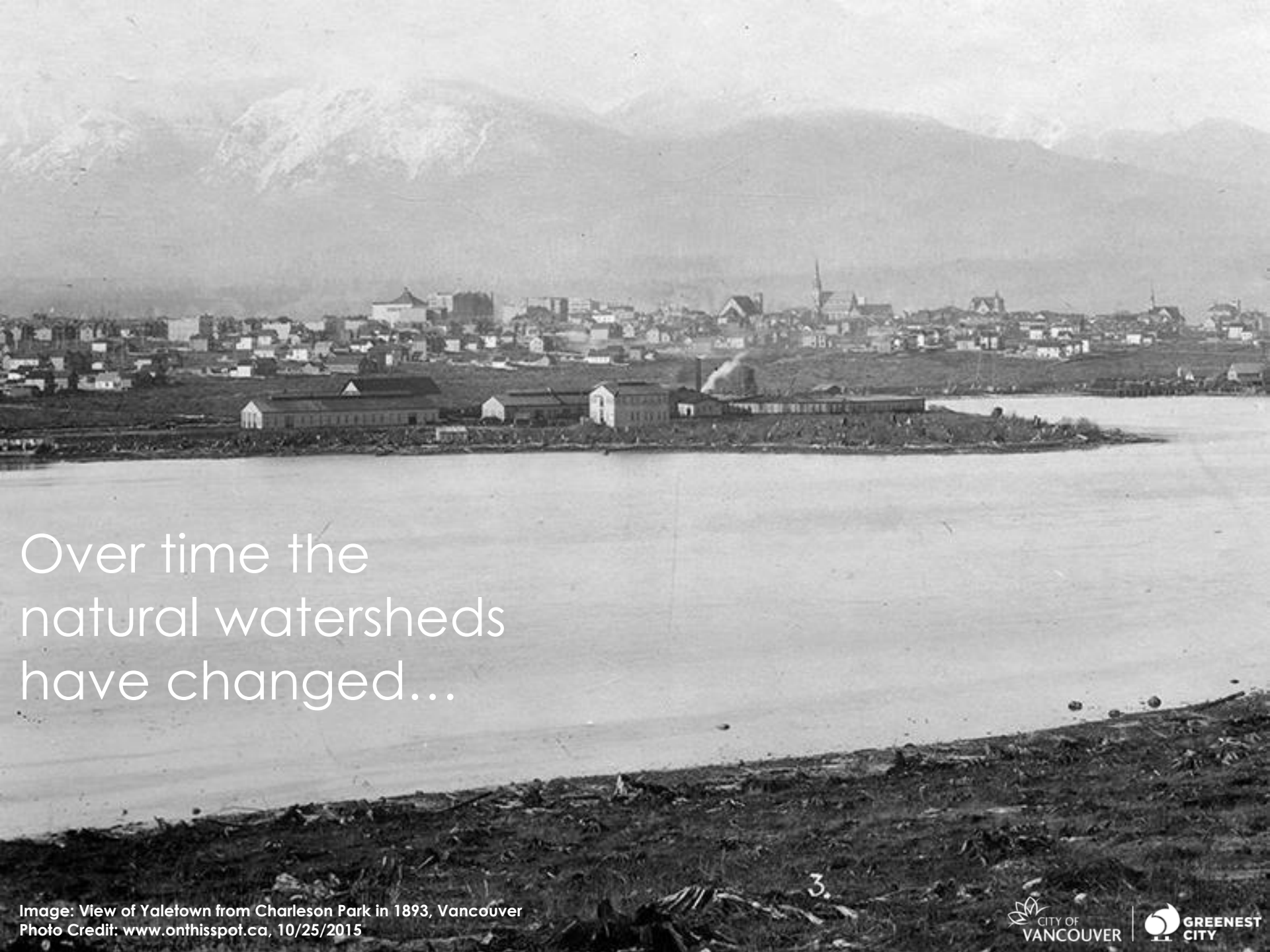


Image: West Hastings Street, Vancouver
Photo Credit: Dan Toulgoet



The city once was a
temperate rainforest

Image: Capilano River Regional Park, North Vancouver
Photo Credit: Robert Pennings



Over time the
natural watersheds
have changed...

to allow residents and businesses
to prosper and grow



Image: View of Yaletown from Charleson Park in 2013, Vancouver
Photo Credit: Wendy de Hoog



extreme rain
events will be
36%
more intense



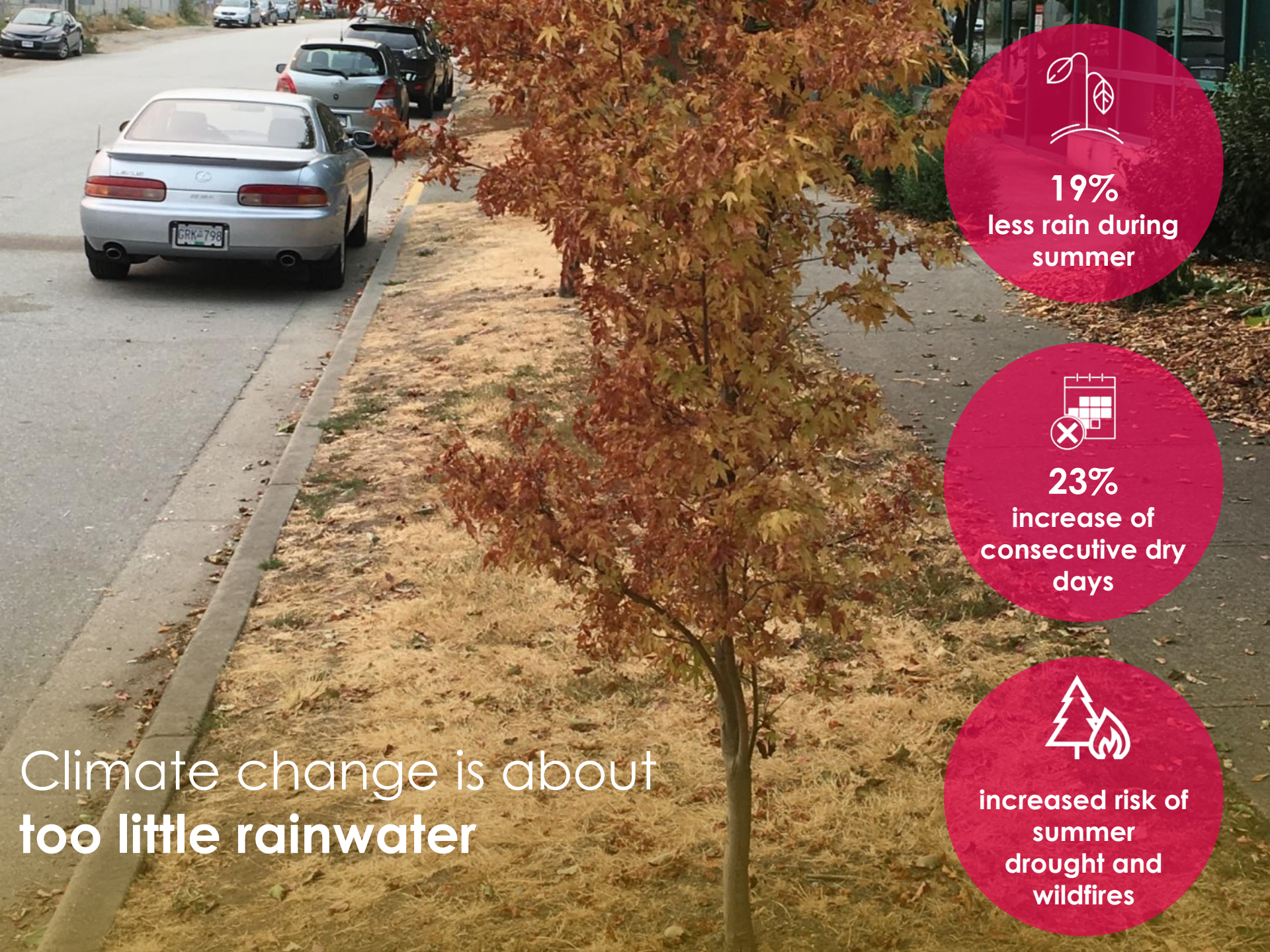
33%
more rain on
very wet days



increased risk of
overland &
coastal flooding

Climate change is about too much rainwater

Image: Overland flooding at Cambie St & W Broadway, Vancouver on October 12, 2017
Photo Credit: Alexandra Coulliard



19%
less rain during
summer



23%
increase of
consecutive dry
days



increased risk of
summer
drought and
wildfires

Climate change is about
too little rainwater

Climate change impacts



**extreme
storms and
floods**



forest fires



**sea level
rise**



**urban heat
island**



**drought
spells**

SHOULD I BE WORRIED?

Other
drivers



SHOULD I BE WORRIED?



SHOULD I BE WORRIED?

Rain City Strategy

9

transformative
directions

3

action plans

A high level, 30-year plan that aims to manage
rainwater through green rainwater infrastructure that

protects

restores

mimics

the natural water cycle

Citywide green rainwater infrastructure implementation target

becomes
business as usual
through

renewal,
redevelopment,
retrofits

<1%

2019

12%

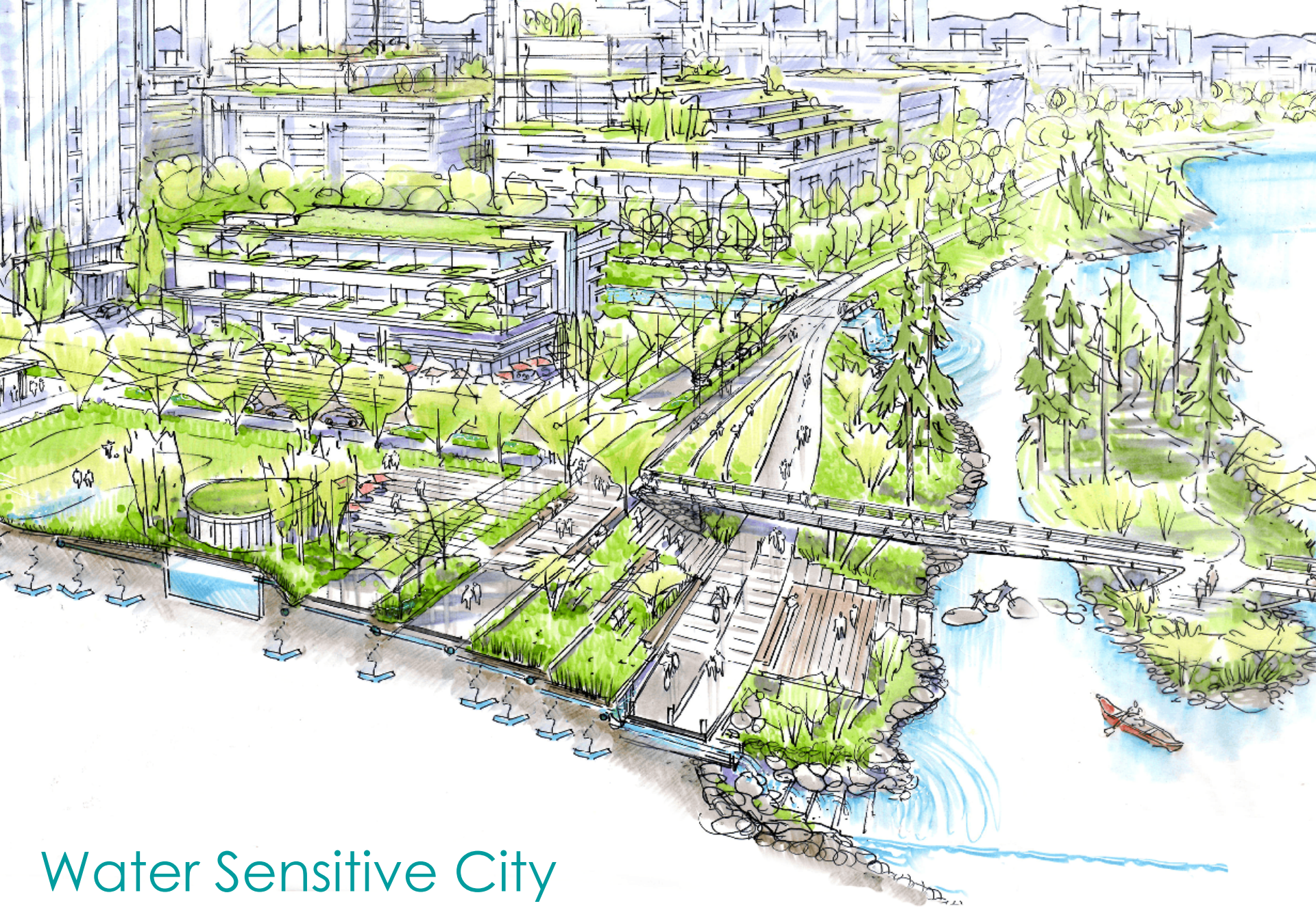
2030

40%

2050

9 Transformative directions

1. Strive to become a **water sensitive city**
2. Respond with urgency to **climate change**
3. Accelerate action to protect the **health and vitality** of surrounding waterbodies
4. Revitalize **watersheds and waterfronts** to enable communities and natural systems to thrive
5. Shape systems to integrate and **value all forms of water**
6. Explore intersectionality, **equity** and Indigenous **reconciliation** through urban water management
7. Drive **innovation** and system effectiveness through data and analytics
8. Enable a culture of **collaboration**
9. Invest in education, capacity building and partnerships to **mobilize action**



Water Sensitive City

Holistic and integrated water management and urban planning

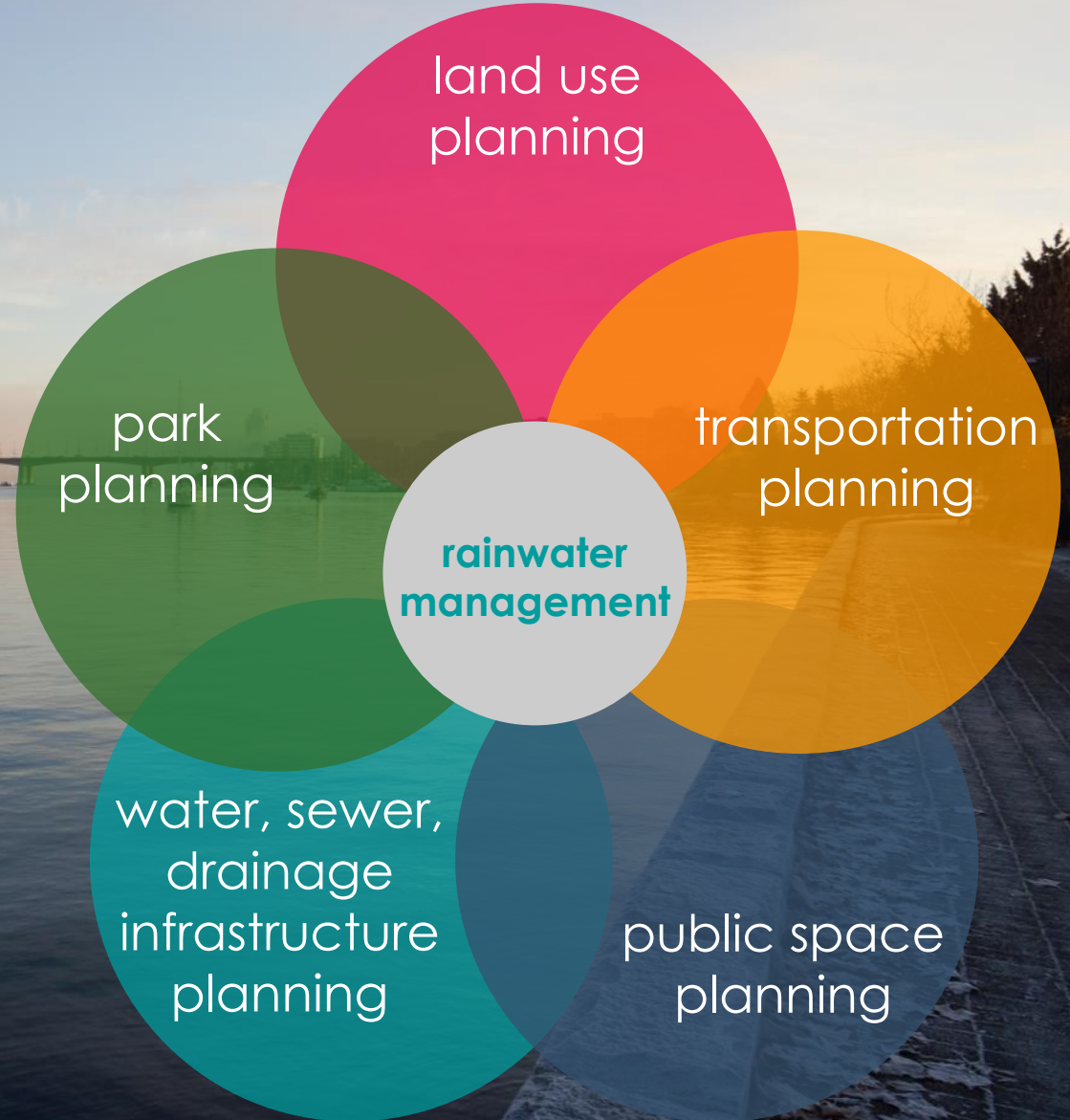
Pillars of a Water Sensitive City

**Cities as
water
supply
catchments**

**Cities
providing
ecosystem
services**

**Cities
comprising
water
sensitive
communities**

Shifting how we manage rainwater in the city



Water Quality Objectives

**reduce
volume of
rainwater
entering the
pipe system**

**reduce
pollutants
in urban
rainwater
runoff**

Current Water Quality Issues

1

Combined
sewer
overflow
(CSO)

Removing rainwater
from sewer pipes will
reduce combined
sewer overflows.

Current Water Quality Issues

2 Urban Stormwater Pollution

Rainwater carries urban pollutants, such as gasoline, motor oil, heavy metals, sediments, litter, organics & fertilizer

Common Stormwater Pollutants

- Total Suspended Solids (TSS)
- Hydrocarbons/oil and grease
- Nutrients
 - P – Phosphorus, TP – Total Phosphorus, Soluble Phosphorus
 - N - Nitrate, Nitrite, TN – Total Nitrogen
- Metals
 - Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Nickel, Zinc
- Microplastics
- Microfibers
- PFCs (perfluorinated compounds)
- Pharmaceuticals

Common Sources of Stormwater Contaminants

USEPA Nationwide Urban Runoff Program (USEPA, 2015)

| Contaminant | Contaminant Sources |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Sediment and Floatables | Streets, lawns, driveways, roads, construction activities, atmospheric deposition, drainage channel erosion |
| Pesticides and Herbicides | Residential lawns and gardens, roadsides, utility right-of-ways, commercial and industrial landscaped areas, soil wash-off |
| Organic Materials | Residential lawns and gardens, commercial landscaping, animal wastes |
| Metals | Automobiles, bridges, atmospheric deposition, industrial areas, soil erosion, corroding metal surfaces, combustion processes |
| Oil and Grease/ Hydrocarbons | Roads, driveways, parking lots, vehicle maintenance areas, gas stations, illicit dumping to storm drains |
| Bacteria and Viruses | Lawns, roads, leaky sanitary sewer lines, sanitary sewer cross-connections, animal waste, septic systems |
| Nitrogen and Phosphorus | Lawn fertilizers, atmospheric deposition, automobile exhaust, soil erosion, animal waste, detergents |

How will nature based solutions improve water quality in Vancouver?



Removal Mechanisms

| Process | Mechanism |
|------------------------------------|---------------------------------------------|
| Volatilization | Evaporation of pollutants |
| Sedimentation | Settlement of heavy particles |
| Adsorption | Attachment to water or soil particles |
| Absorption | Soaking deeper into groundwater |
| Microbial Action | Pollutants broken down by bacteria |
| Plant Resistance and Uptake | Plants absorb some pollutants into microbes |
| Filtration | Particle capture |

Source: Stiffler, 2013

Soil Amendments

| Amendment | Remediation Outcome |
|---------------------------------------|-----------------------------------------------------------------|
| Fungal Biomass | Increased PCB and hydrocarbon breakdown |
| Bacterial Biomass | To promote denitrifying bacteria |
| Nemotodes | Pollutant breakdown, improved plant health |
| Biochar (activated carbon) | Improved soil adsorption of heavy metals. Breakdown of Nitrogen |
| Woodash | Improved plant growth, microbial activity |
| Coconut Coir | For Phosphorus Removal |



absorbent
landscape



blue-
green
roofs



rainwater
harvesting



rainwater
tree
trenches



permeable
pavement

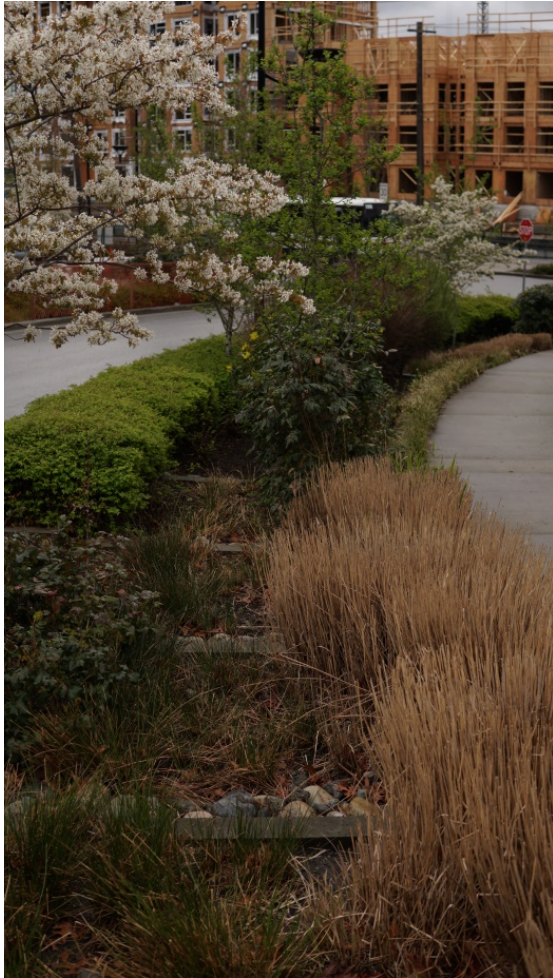


wetland



bioswale

234 ASSETS IN VANCOUVER



143 bioretention (61%)



**38 permeable
pavement (16%)**

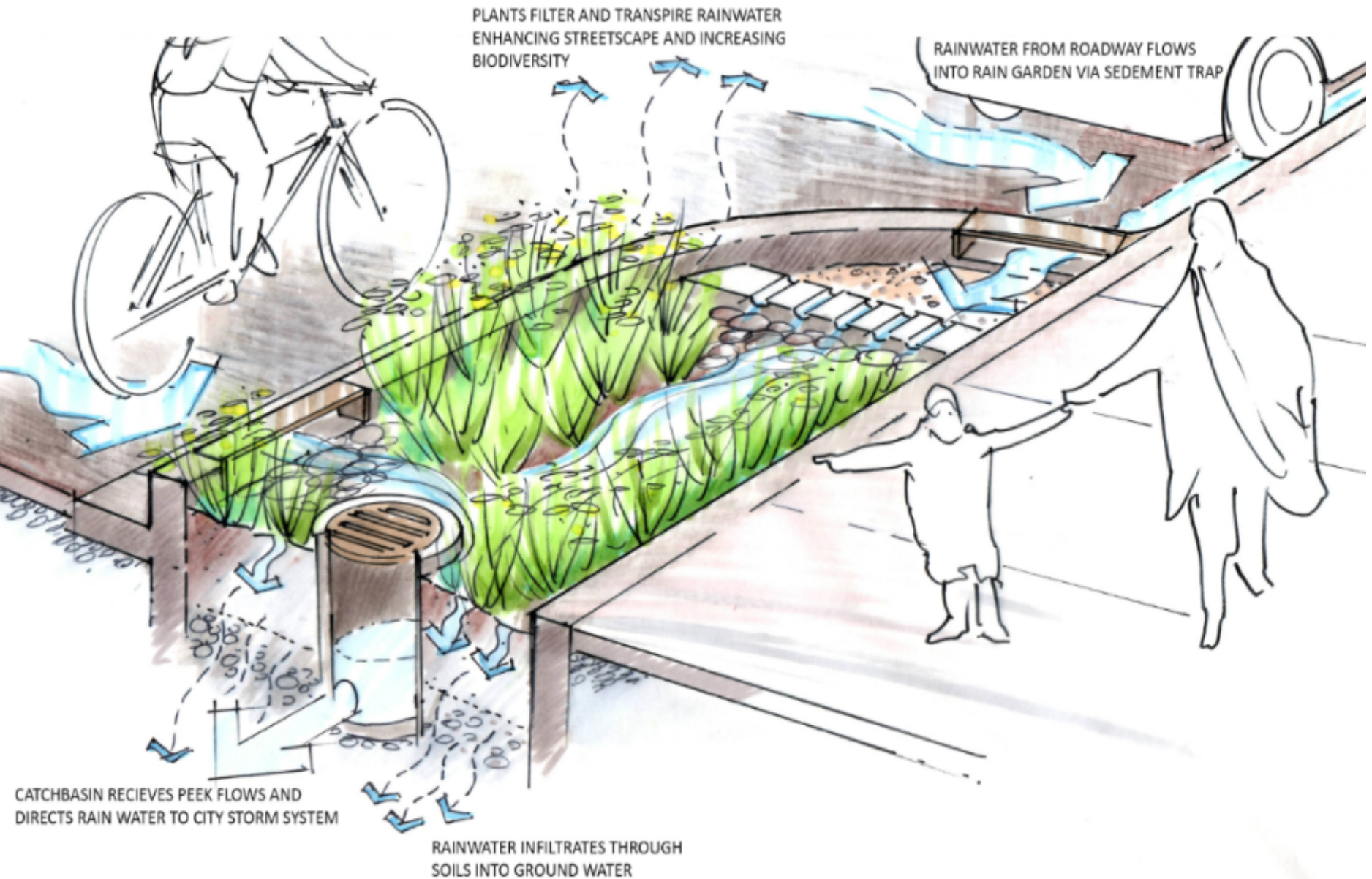


**5 Rainwater tree trenches
(2%)**



**48 sub-surface
infiltration (21%)**

Small Scale Practices

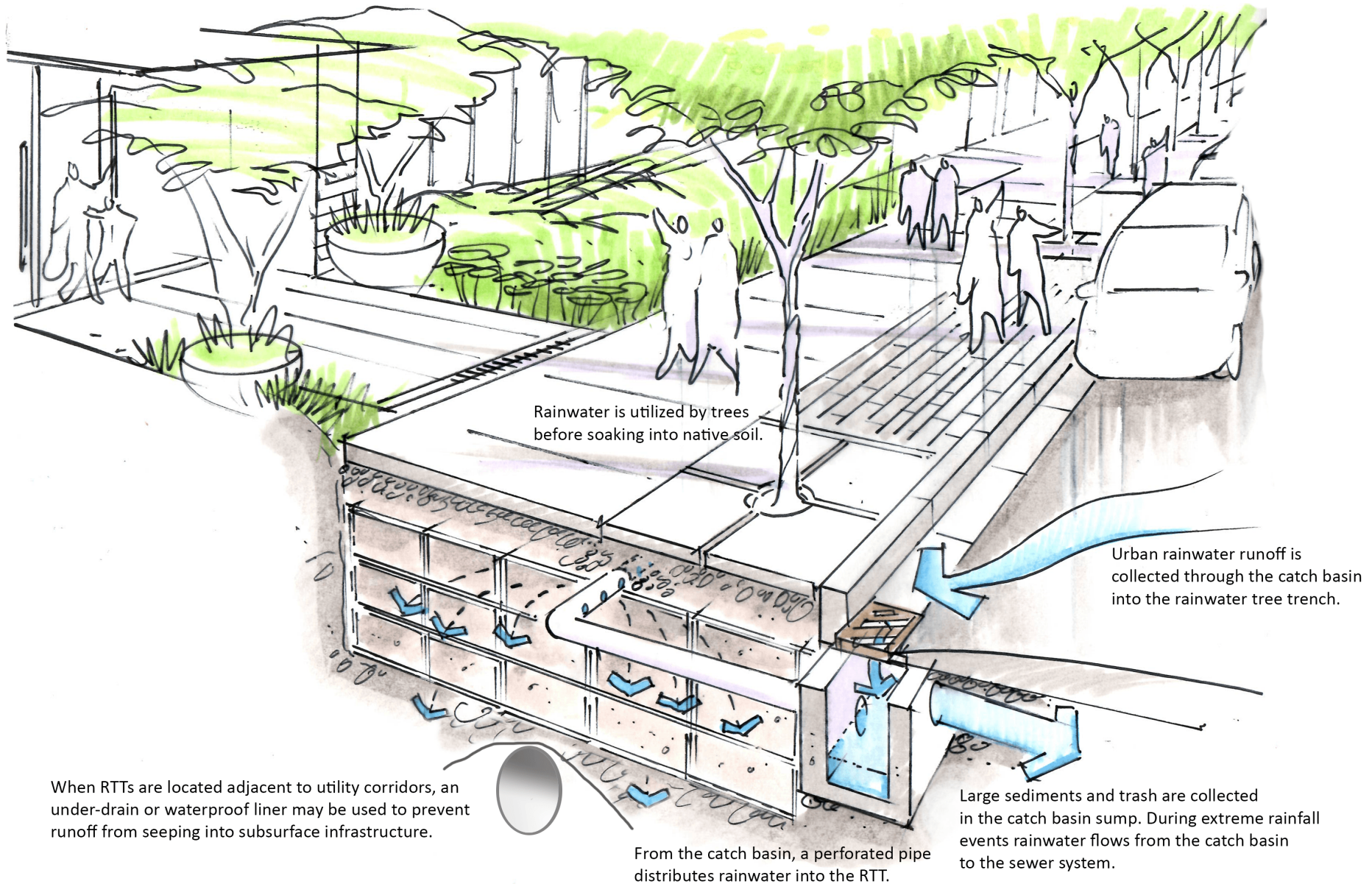




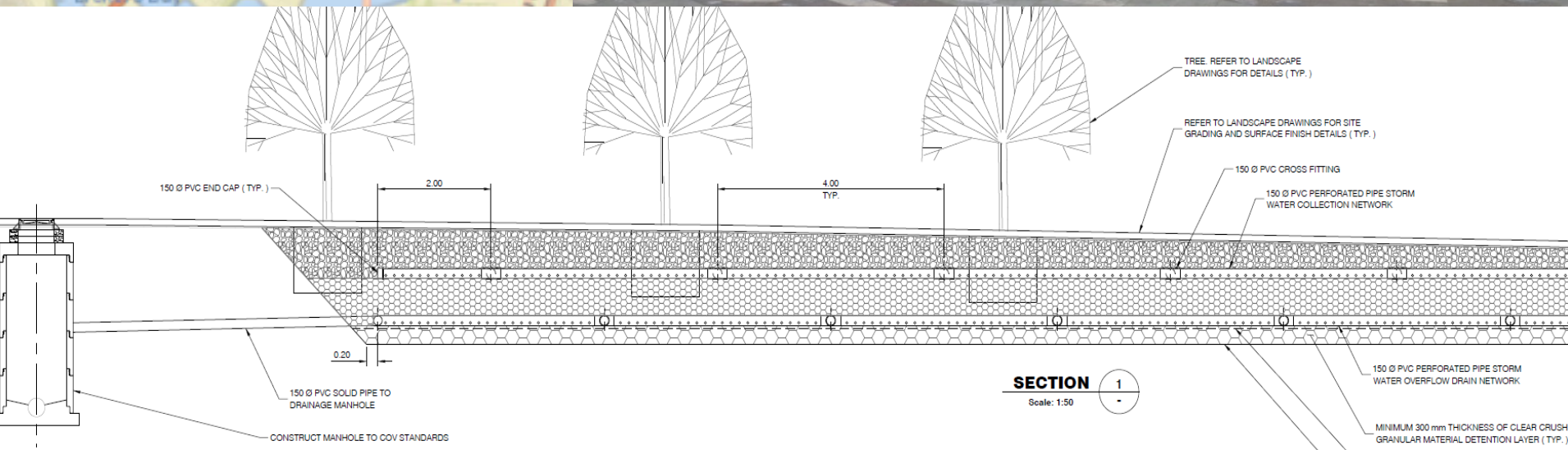
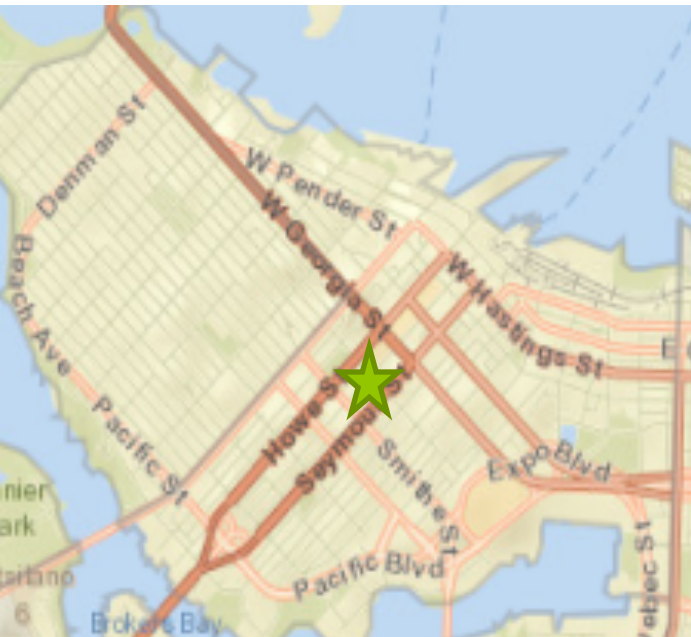
Windsor St & 22nd Ave.



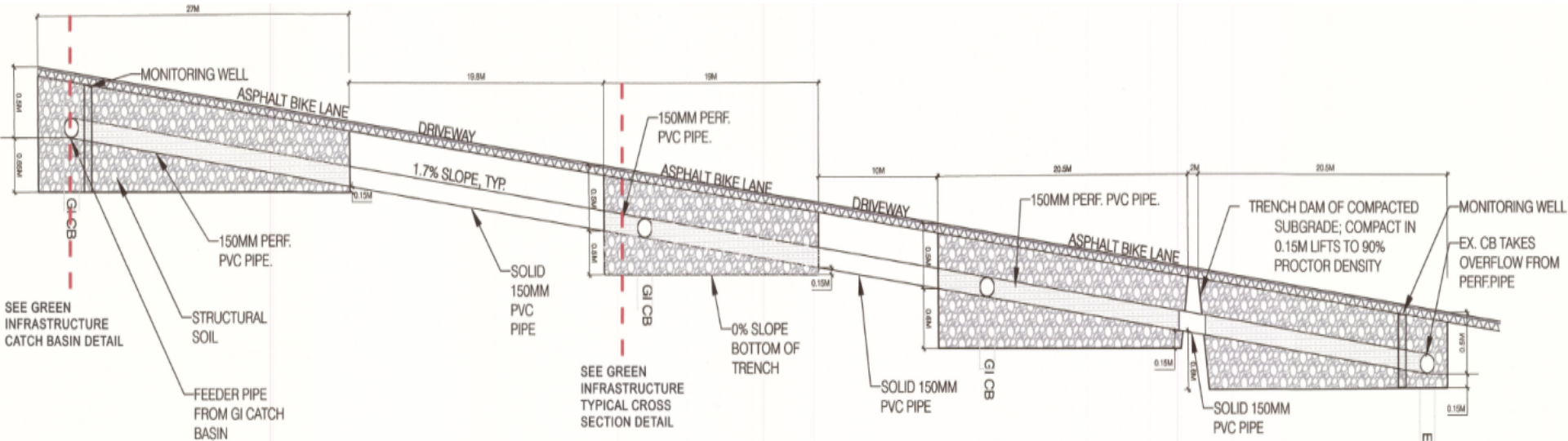
Site Scale Systems



Rainwater Tree Trenches for Plazas



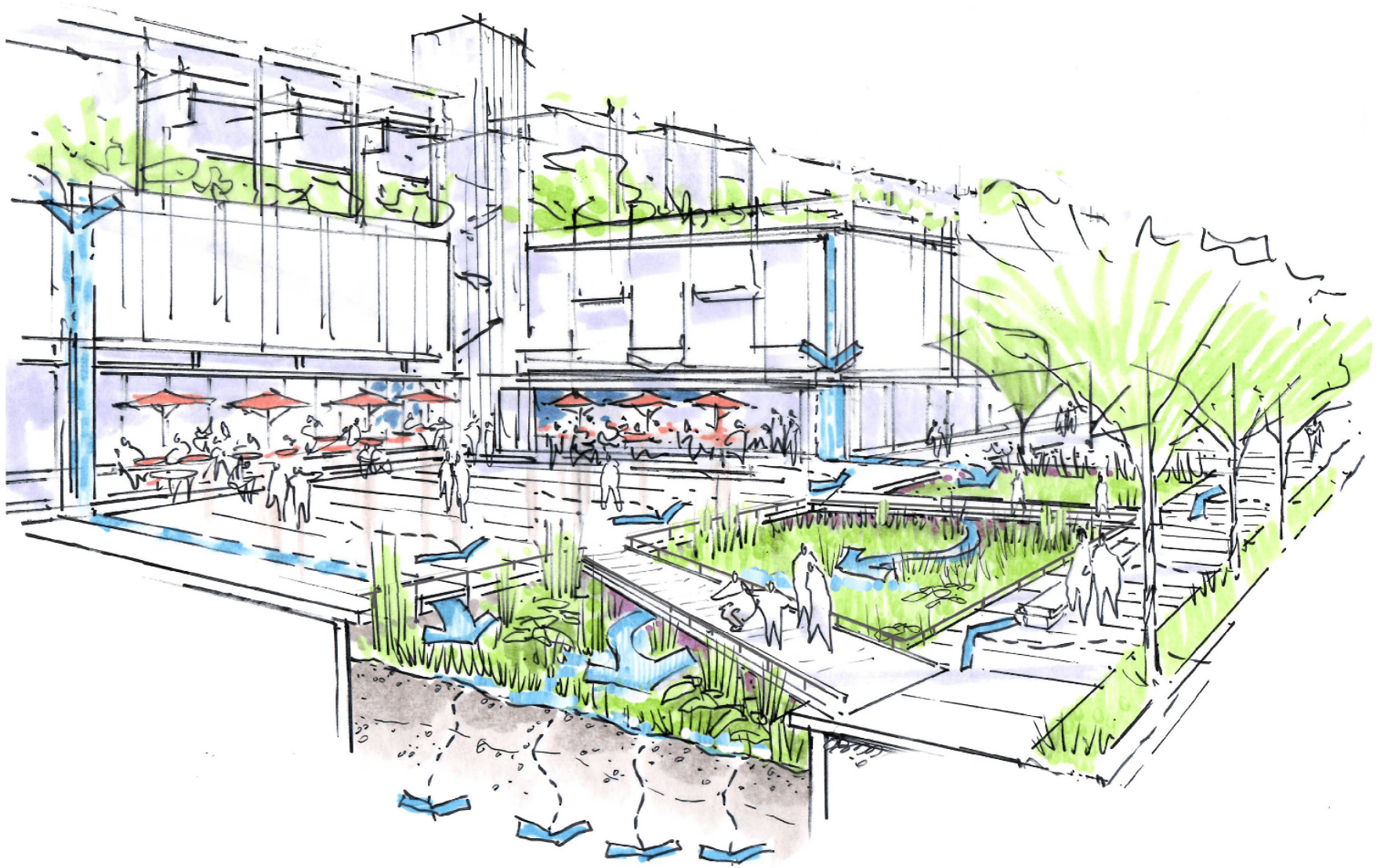
Rainwater Tree Trenches For Bikeways



Quebec & 1st, Vancouver Rainwater Tree Trenches

- ✓ Rainwater management
- ✓ Enhanced Tree Canopy
- ✓ Ecosystem Services

District Scale Systems



Blue-Green Networks



A park-like
connector street
network with a more
natural form
integrating overland
flow and significant
infiltration
opportunities

63rd and Yukon, Vancouver Neighbourhood-Scale Green Infrastructure



- ✓ Rainwater management
- ✓ Public Amenities
- ✓ Ecosystem Services

HINGE PARK, VANCOUVER

Neighbourhood stormwater wetland & beaver habitat

Wetland manages
2/3 of street run-off
for Olympic village
neighbourhood



Looking ahead

Performance
monitoring – data
driven decisions

Inter-disciplinary
collaboration

Community,
public & private
sector action





Thank you!

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