PROJECT 3
ENHANCING Green Networks and Fabric

Vision for greenways and habitat areas, Portland 2035 Comprehensive Plan (2016)

In this project, we will look into the future and make propositions for improving the quality, connectivity, and functioning of the green networks and fabric in your study area. This is an individual project.

Learning objectives

• Learn to think in planning and design terms— respond to the analysis of the study area with future propositions that will repair and improve on the existing conditions

A. SITE-WIDE PROPOSITION

Responding to your team's diagnosis of your study area, and the ideas for improvements from Project 2, each individual will make site-wide propositions for how to make significant improvements to the green networks and fabric of your study area. Feel free to discuss this with your team and coordinate your proposals.

• What strategies can be undertaken to improve the quantity and quality of the green network?
• What are the opportunites to improve the connectivity between the green patches in your study area?
+ Anything else you wish to recommend...

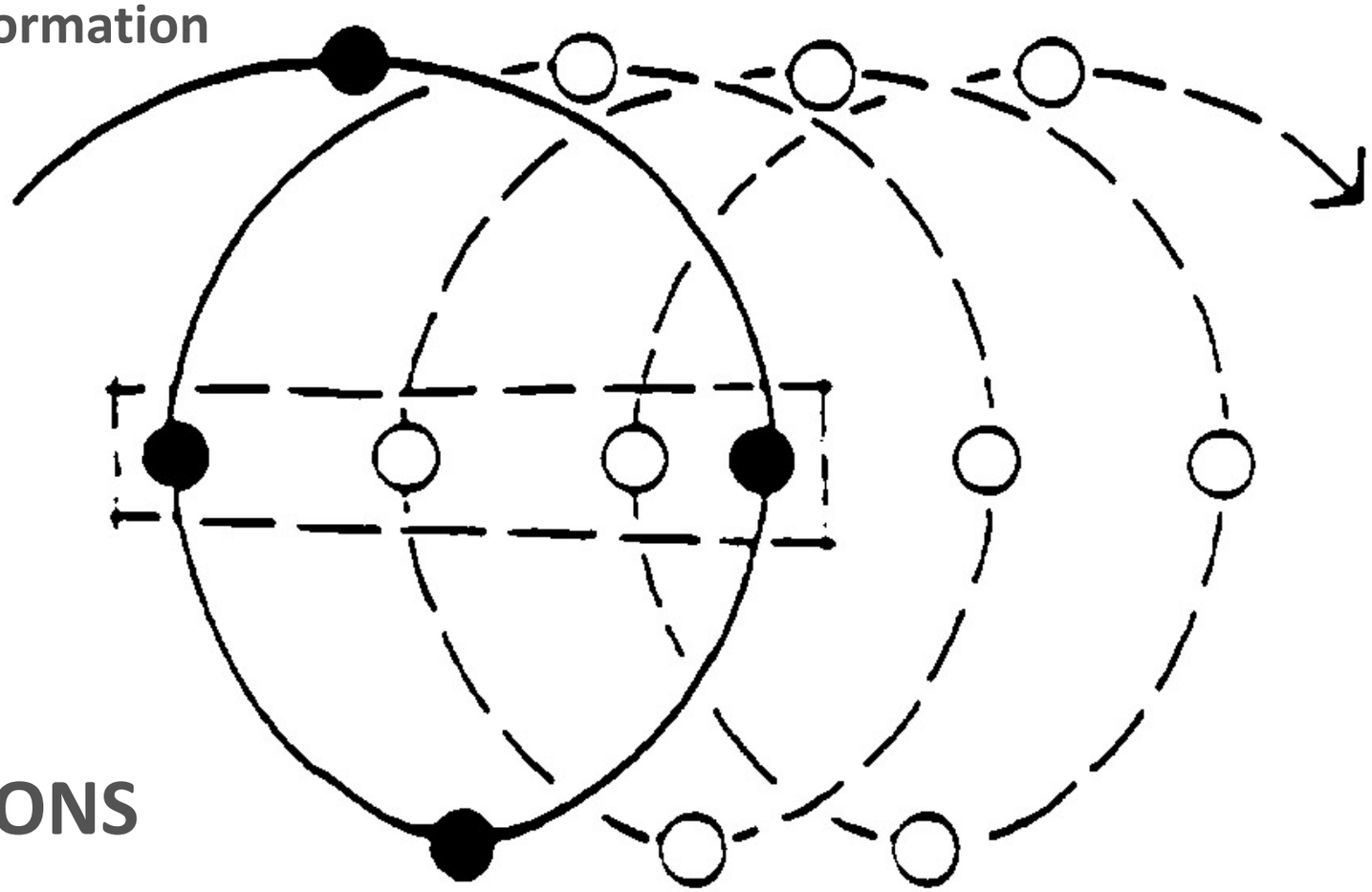
POLICY CONTEXT:
Situate your propositions in the relevant policy context. Find at least three municipal goals, objectives or targets that your propositions support and help to accomplish (for example, the City's Goal 7 in Vanplay Restore Vancouver's Wild Spaces, or the target that everyone should be within a 5 minute walk of nature is another). See the lists of policy documents below.
Clearly list these goals or targets and state how your propositions help to accomplish them.

DIAGRAM:
Create a diagram to explain your ideas. i.e. represent your site-wide propositions as one or more diagrams on a map(s) of your study area.
Diagrams should include clear graphics with legends.
Briefly explain the main concepts in the diagram.

Project 3 Enhancing Green Networks and Fabric

PROJECT 2

Background information



Analysis:

Issues &

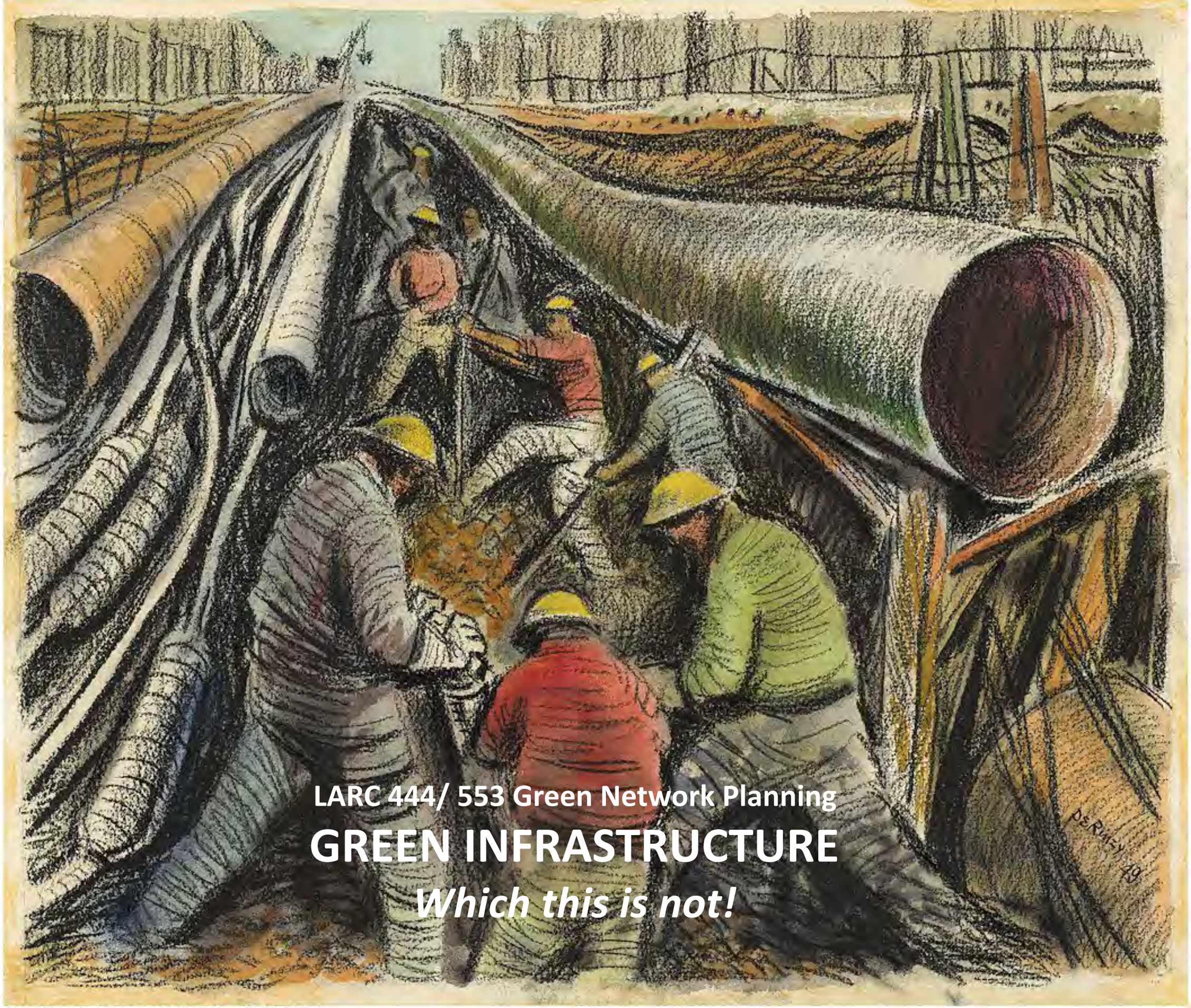
opportunities

PROPOSITIONS

Girling 1980 from Halprin's RSVP Cycles 1974

Project 3 Enhancing Green Networks and Fabric

- examples



John DeRinzy, City of Toronto Archives, Date unknown

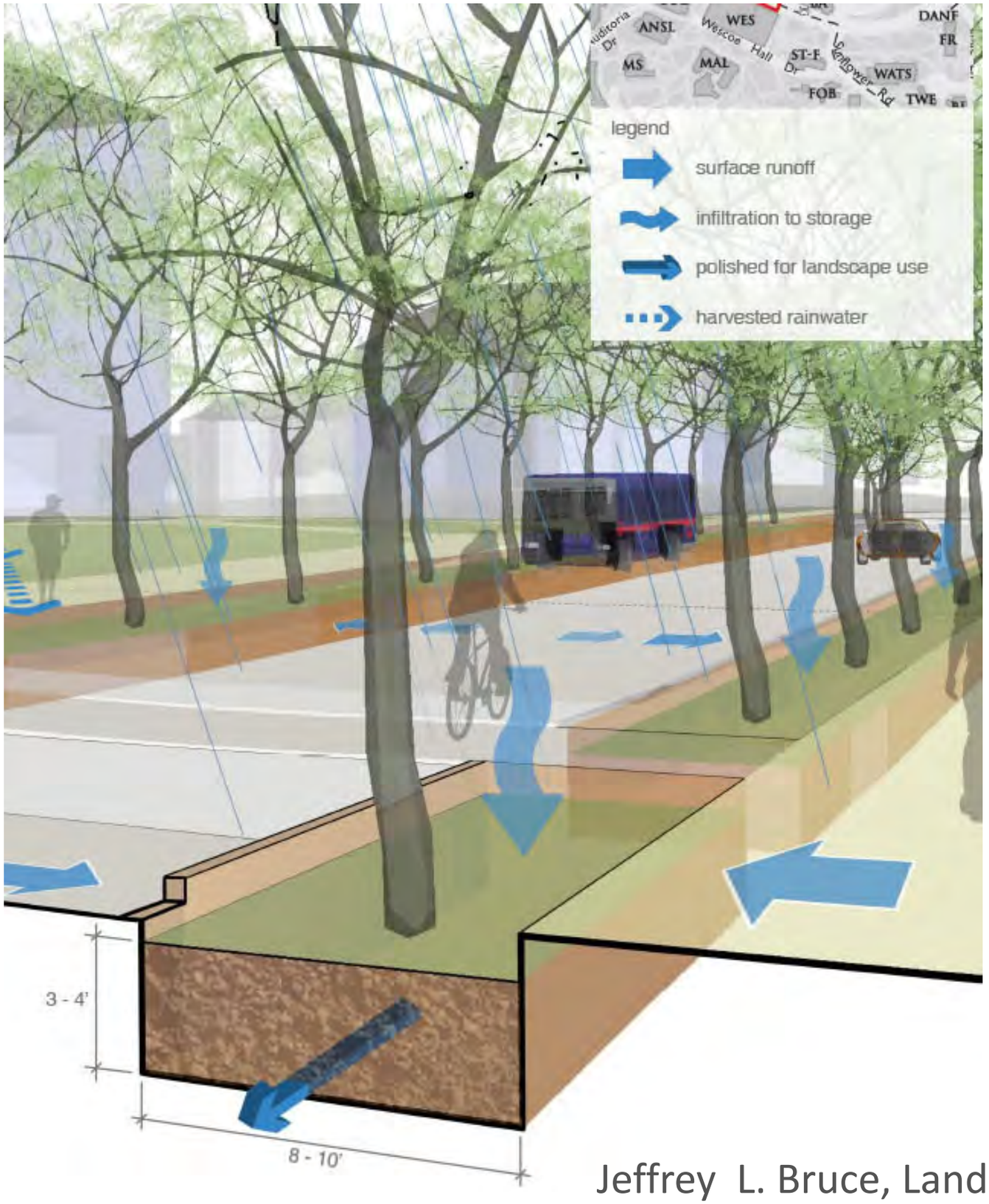
City of Toronto Archives Series 259 s0259 it0004

LARC 444/ 553 Green Network Planning

GREEN INFRASTRUCTURE

Which this is not!

GREEN INFRASTRUCTURE



TODAY:
Why green infrastructure?

Define green infrastructure

GI Principles & tools

Vancouver's IRMP

Jeffrey L. Bruce, Landscape Architect

South Los Angeles

ROAD, TRANSPORTATION IMPACTS

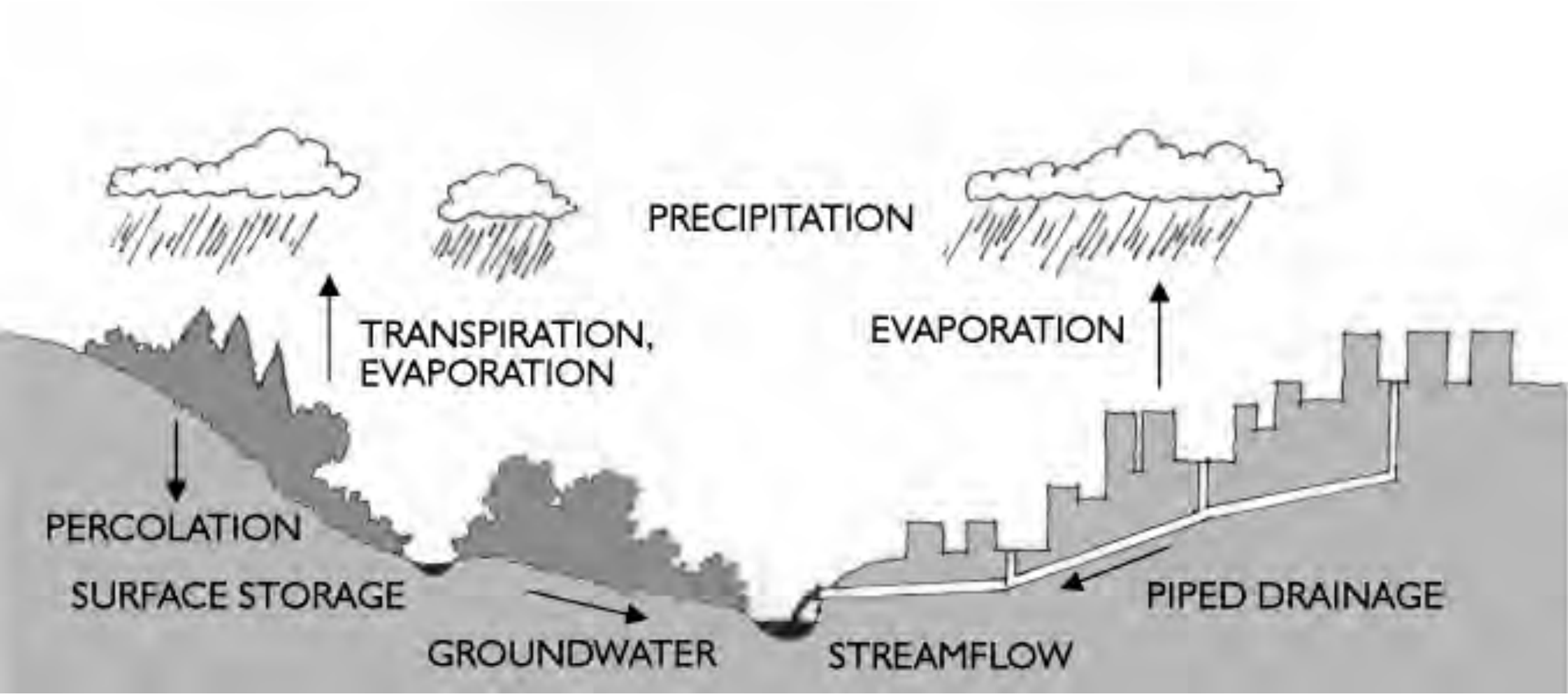
> 25% of land area of cities is road infrastructure

IMPACTS of road infrastructure and transportation sector:

- GHG emissions + climate change
- air pollution- particulates
- noise pollution
- water pollution
- broad ecosystem impacts on waterways
- habitat fragmentation

US Environmental Protection Agency

WATER: CONVENTIONAL URBAN "STORMWATER" MANAGEMENT



NATURAL | URBANIZED
HYDROLOGY

Keep the city dry at all costs!
Get the water out of town!
"stormwater" = waste

Girling & Kellett 2005, p. 123

CONVENTIONAL URBAN “STORMWATER” MANAGEMENT

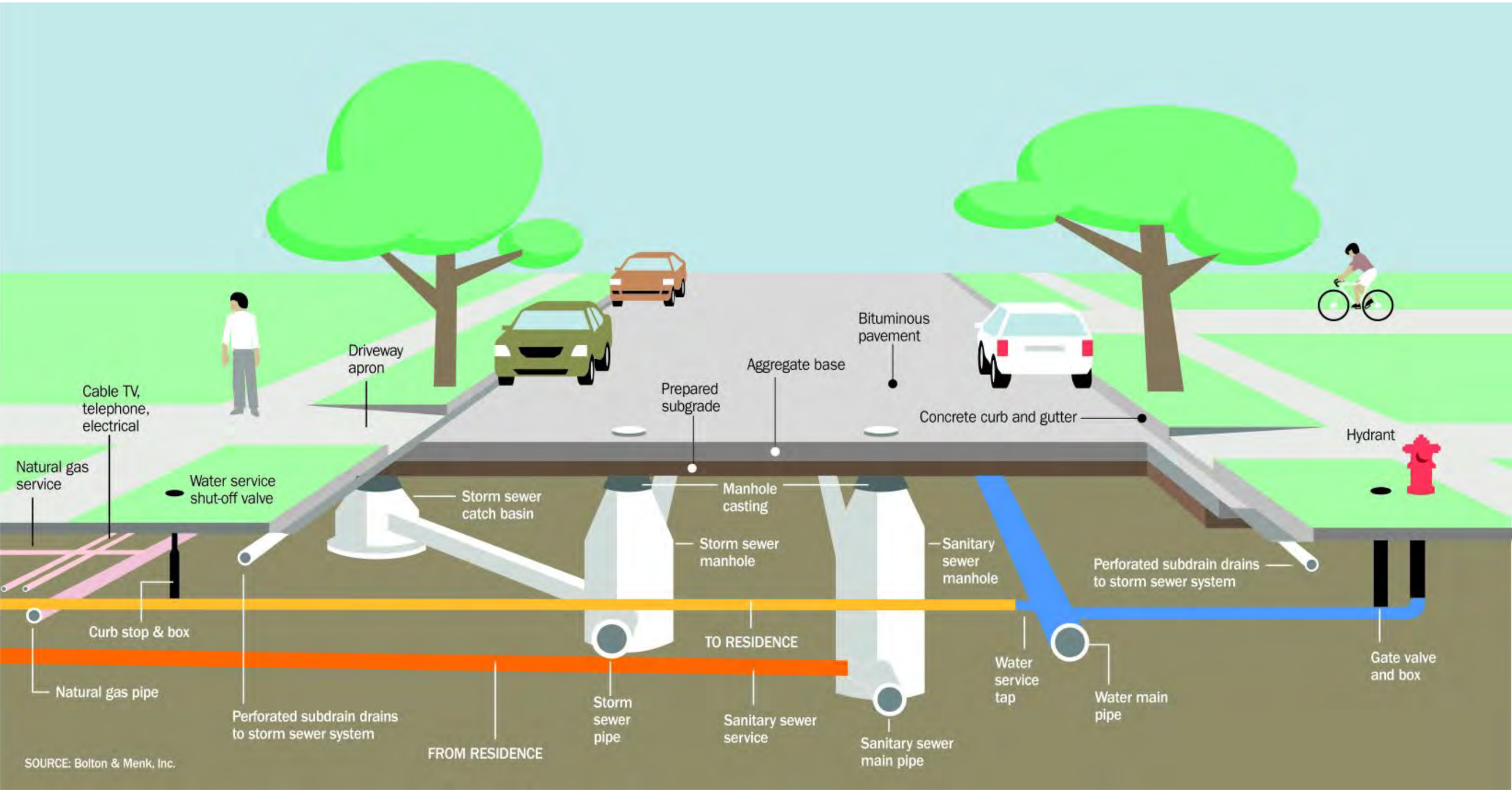


Image by Ruhnd Design (from web)

CONVENTIONAL URBAN “STORMWATER” MANAGEMENT

Disrupts natural hydrology

Damages stream structure and aquatic habitat

Sends polluted water to streams, lakes, rivers

Seals water out of the ground, drying up groundwater

cleanwatercampaign.org

STREETS

~25% total urban land area

50% total impervious surfaces

50% total urban runoff

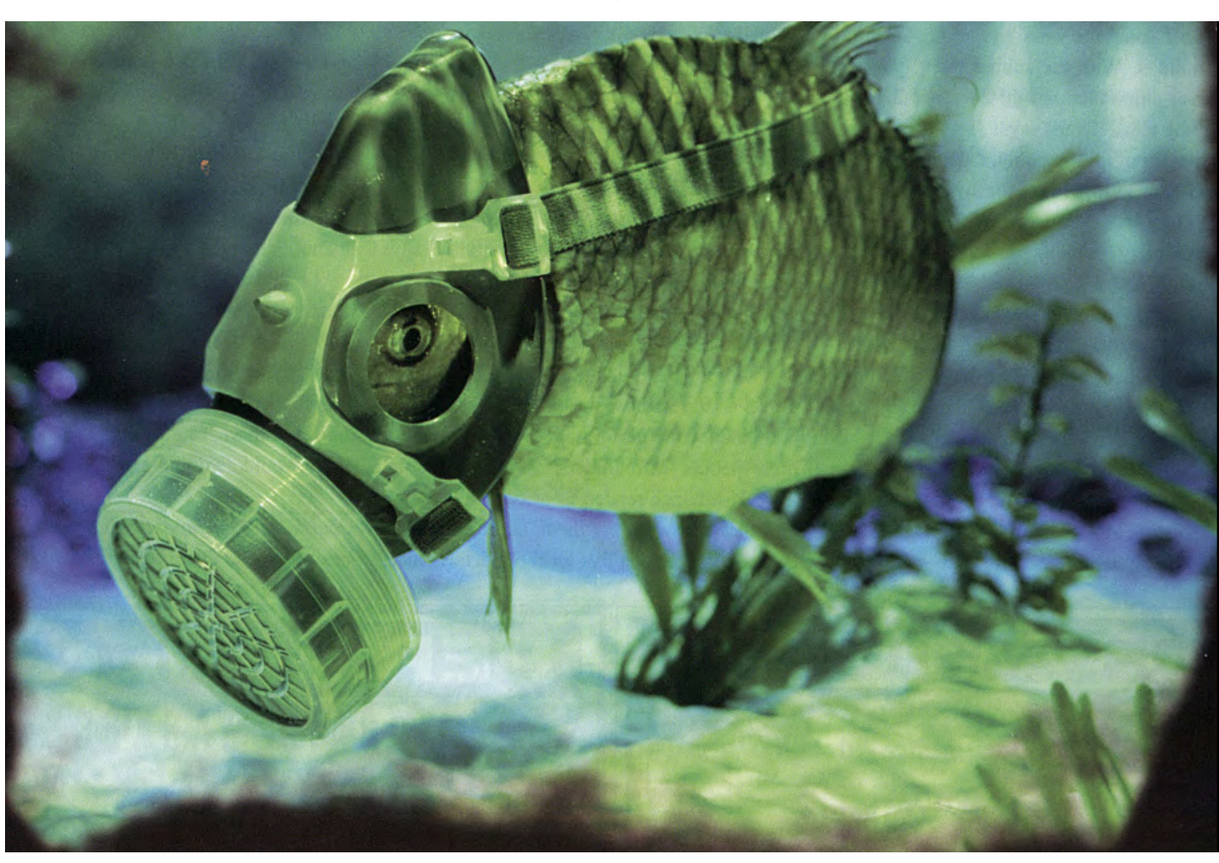
65% total urban (water) pollutants

Portland Bureau of Environmental Services

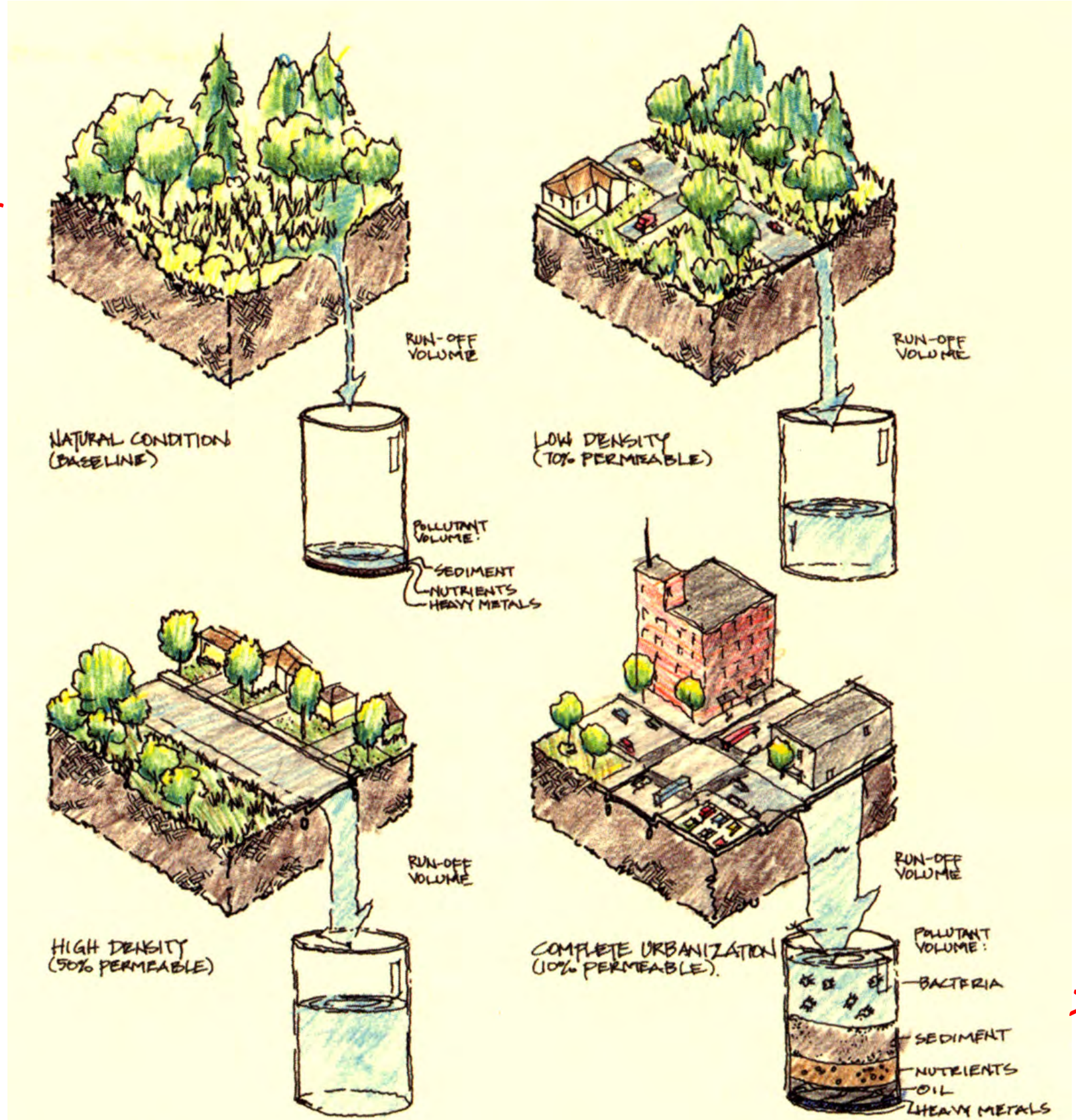
Typical urban pollutants:

Suspended solids
Phosphorous
Nitrogen
Fecal coliform
E. Coli
Hydrocarbons

Cadmium
Copper
Lead
Zinc
Chlorides
Insecticides
Herbicides



<10% runoff



Effects of Impervious Land on Runoff Quality and Quantity

>90% runoff

Green Streets, Portland Metro

WHAT IS GREEN INFRASTRUCTURE?

GREEN INFRASTRUCTURE: Multiple meanings

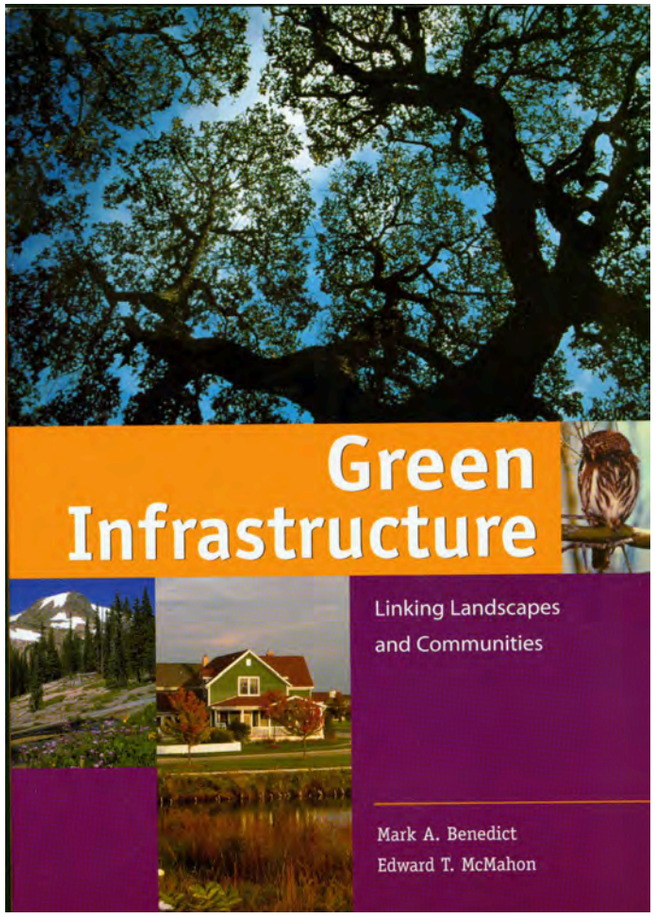
Green networks?

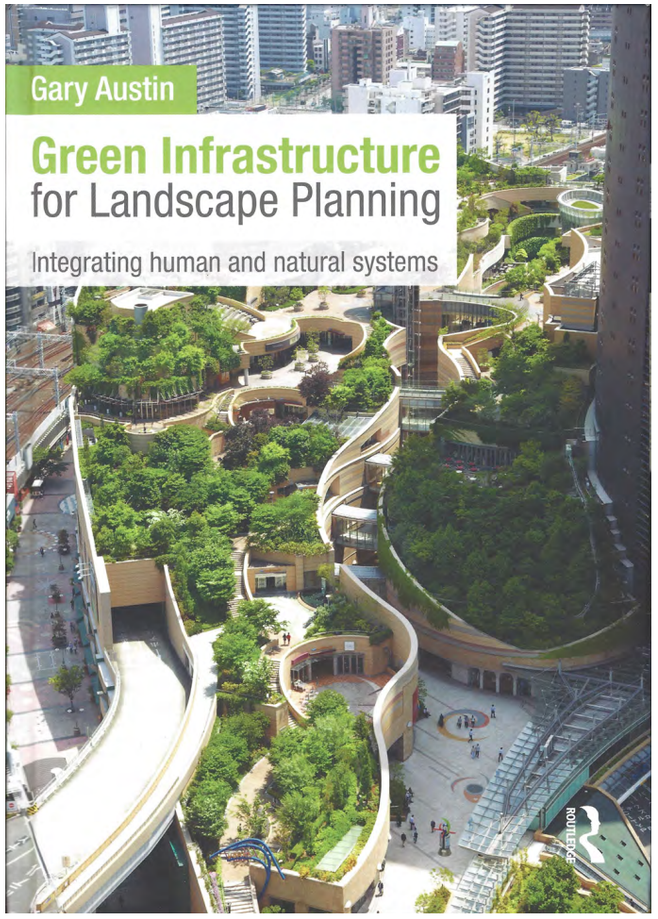
OR

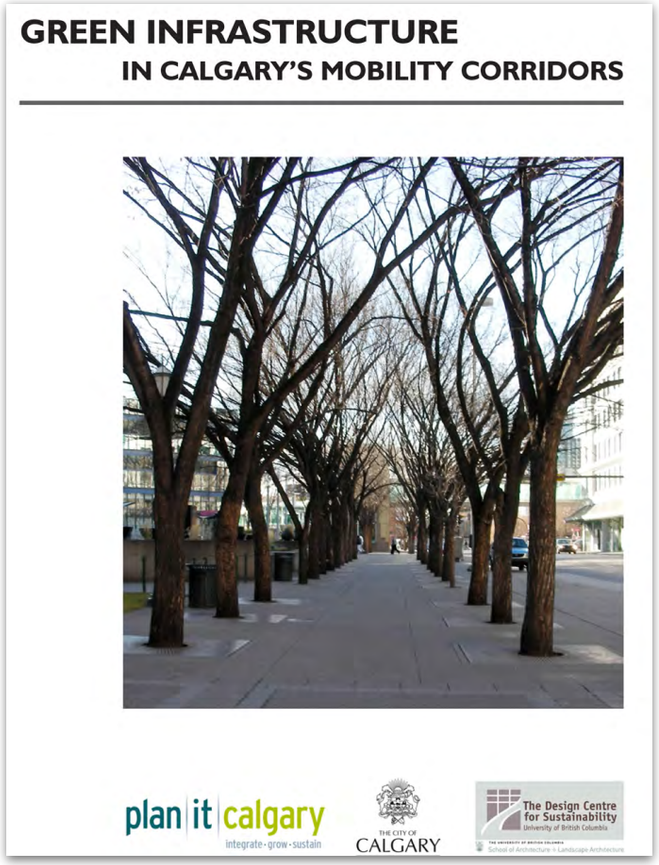
Greening gray infrastructure?

OR

The urban forest?







INFRASTRUCTURE = the system of public works of a [city] Miriam Webster

i.e. transportation networks, water supply, sewage treatment, power networks- **gray infrastructure**

Austin: foundational systems of a city interconnected by networks

"GREEN" = systems that provide ecosystem services

all urban vegetation, and functioning "natural" hydrology

GREEN INFRASTRUCTURE = green infrastructural systems

1) GREEN INFRASTRUCTURE: *EVERYTHING GREEN?*

ASLA on Green Infrastructure:
Green infrastructure covers everything from parks to street trees and green roofs to bioswales -- really anything that helps absorb, delay, and treat stormwater, mitigating flooding and pollution downstream

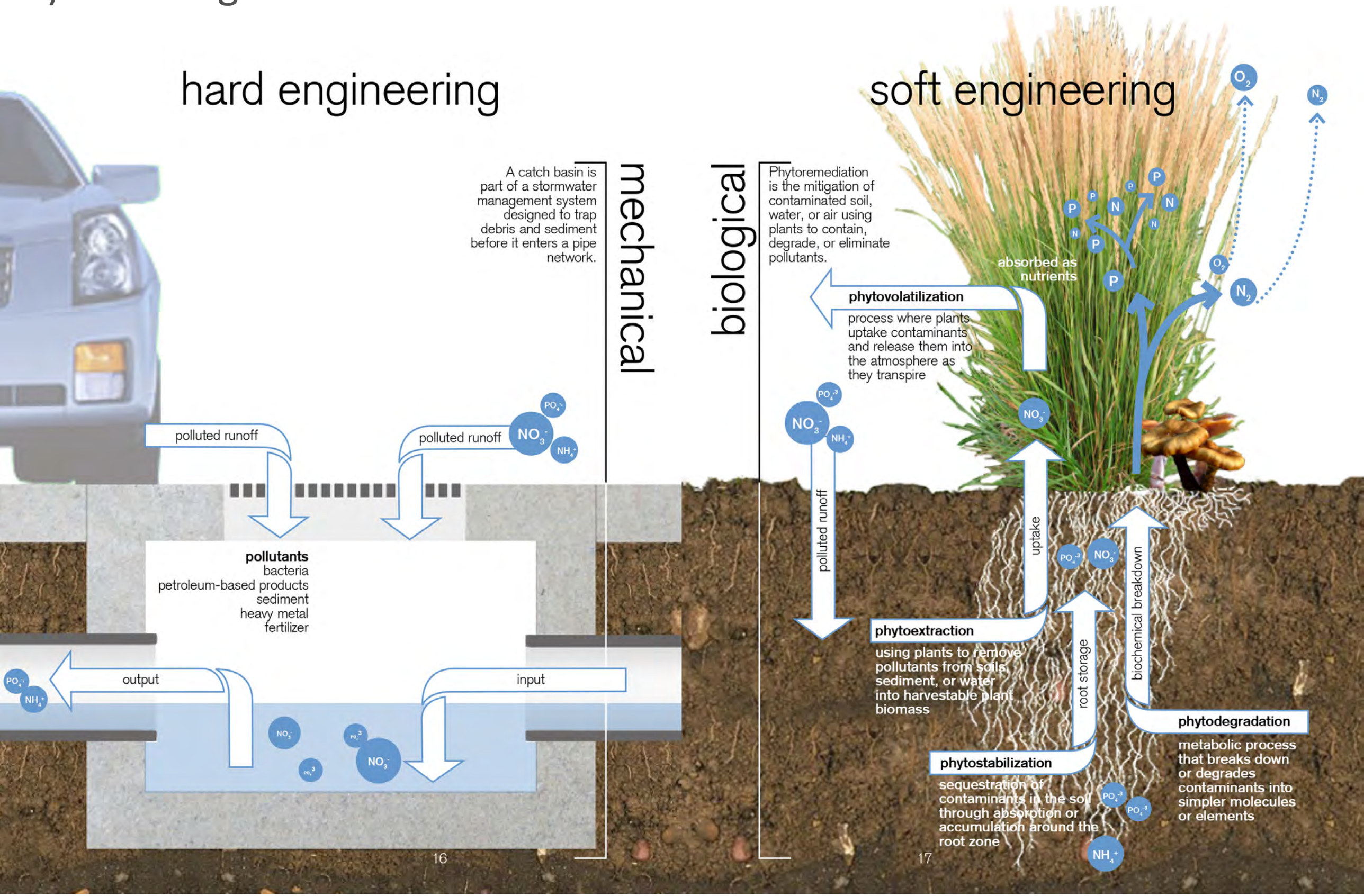
2) Greening the GRAY INFRASTRUCTURE

"***by greening our gray infrastructure*** (buildings, roads, bridges, pipelines, etc.)— effectively softening the lines between the human-made and natural environments— we can **create urban systems that** serve human needs and **protect and restore environmental quality**."

Steve Nicholas,
City of Seattle Office of Sustainability
www.djc.com/news/en/11135643

Crown Street, Vancouver

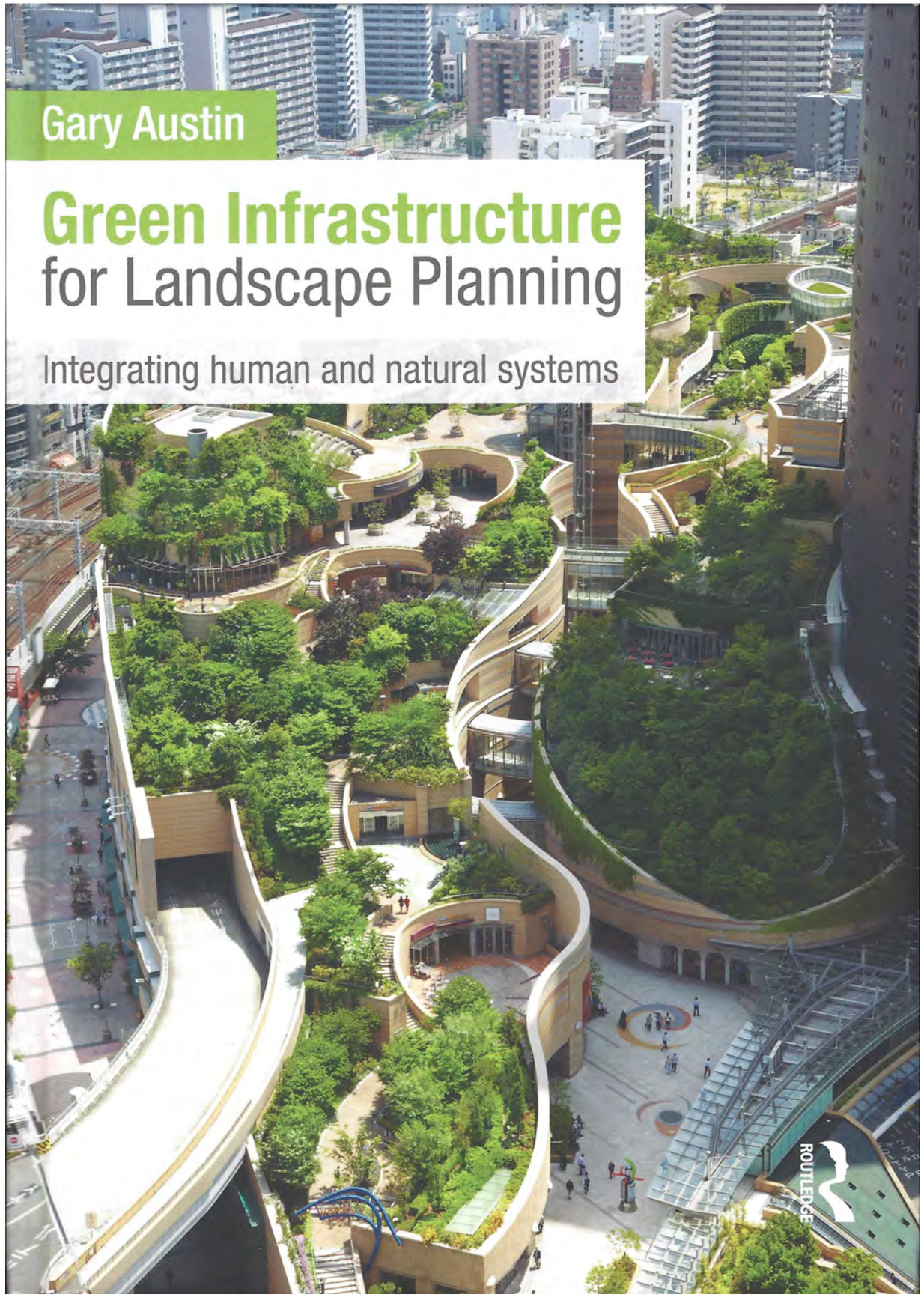
2) Greening the GRAY INFRASTRUCTURE



UACDC Low Impact Design Manual 2010

3) GREEN INFRASTRUCTURE: *PERFORMS ECOSYSTEM FUNCTIONS*

"a ***continuous network*** of corridors and spaces, planned and managed to sustain healthy ***ecosystem functions***" …to generate human benefits i.e. ecosystem services



3) GREEN INFRASTRUCTURE: *PERFORMS ECOSYSTEM FUNCTIONS*

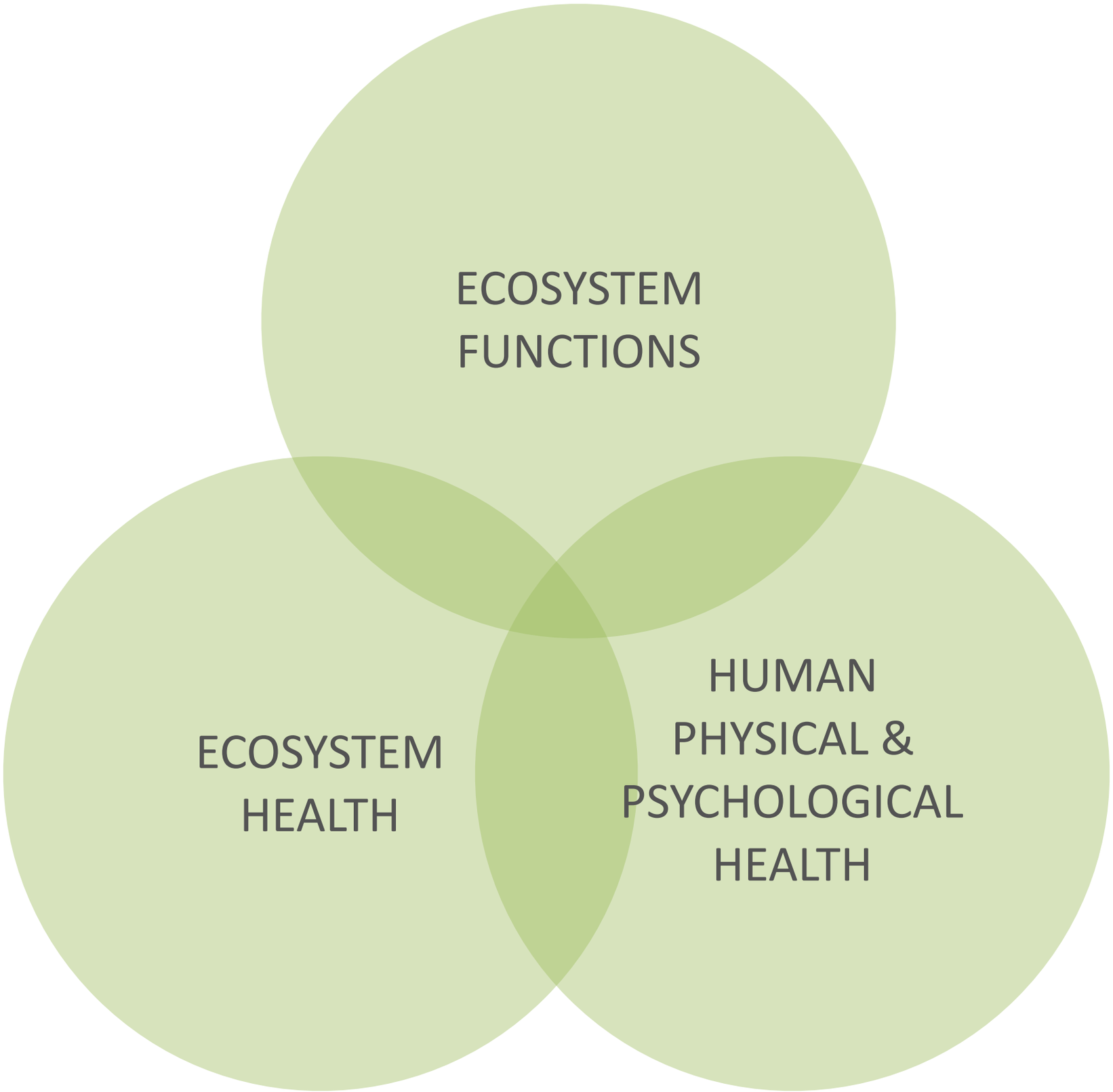
US Environmental Protection Agency

"Green infrastructure [strategies] infiltrate, evapotranspire, capture and reuse rainwater...***to maintain or restore natural hydrologies***."

"green infrastructure practices include rain gardens, porous pavements, green roofs, infiltration planters, tree [planting] and rainwater harvesting"

Crown Street, Vancouver

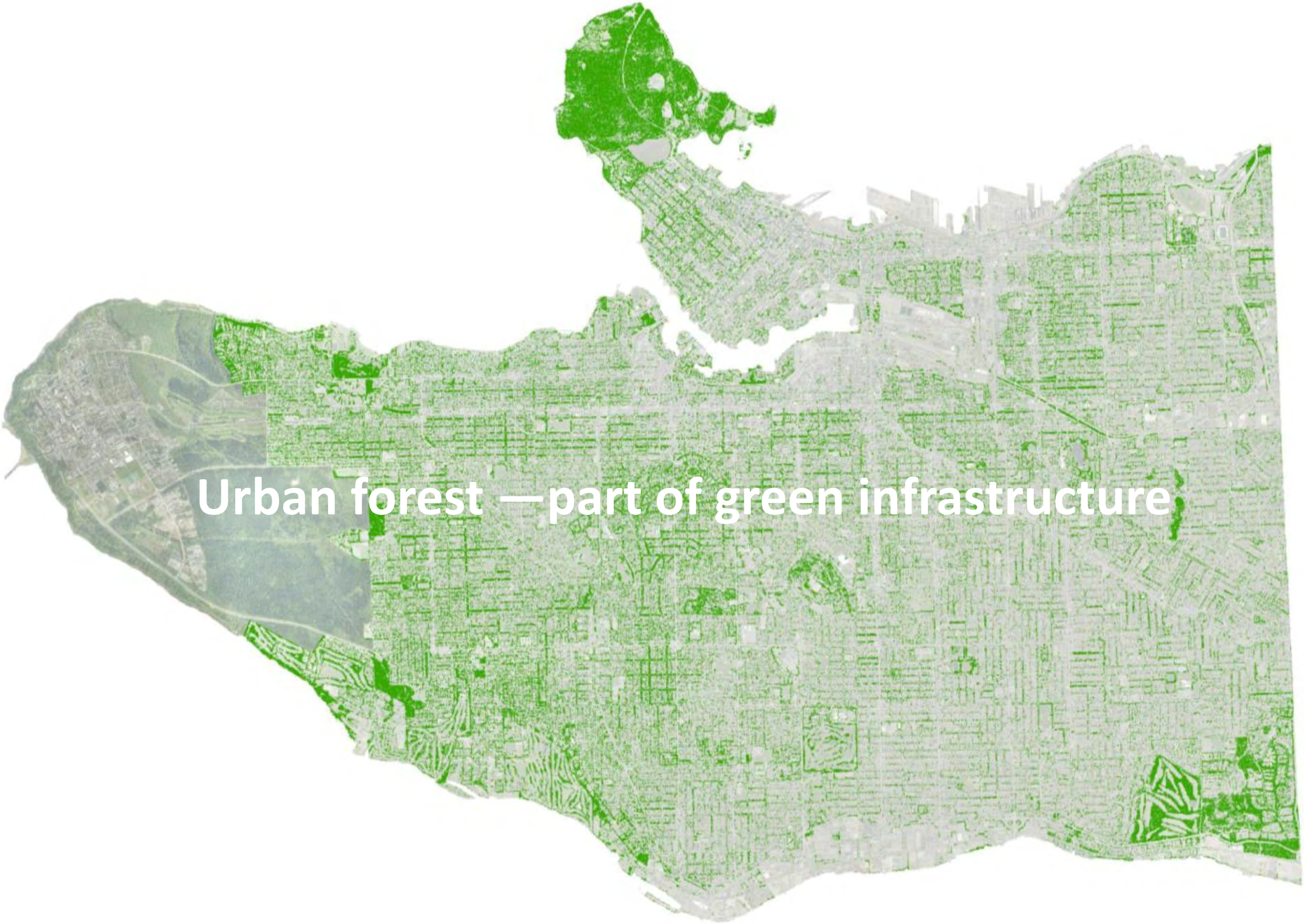
4) GREEN INFRASTRUCTURE: *PROVIDES ECOSYSTEM SERVICES*



ECOSYSTEM
SERVICES

Austin's model adapted by Girling

URBAN FORESTS: *PART OF GREEN INFRASTRUCTURE*

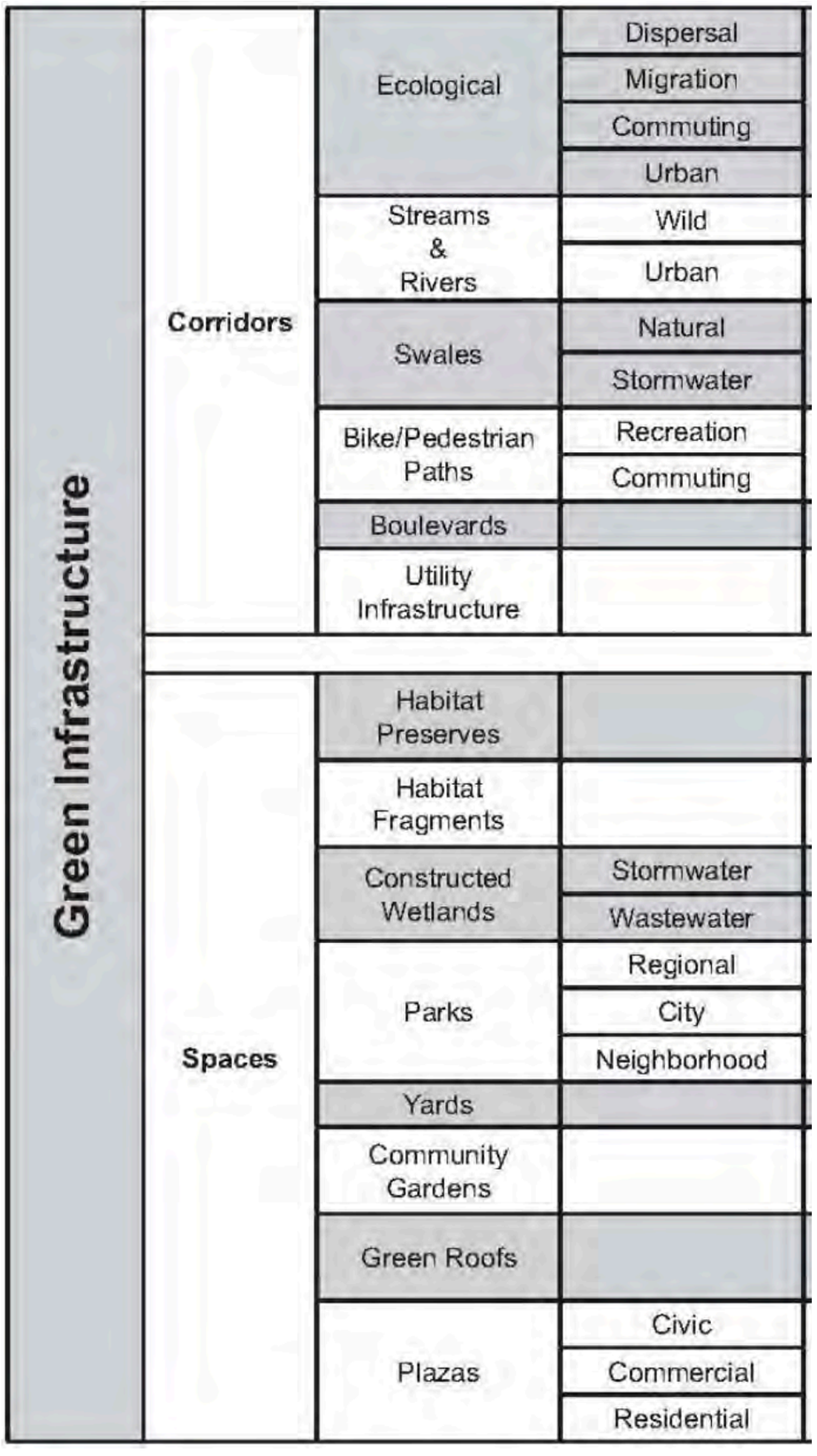


ELEMENTS of GREEN INFRASTRUCTURE (Austin)

Types Scale/function

networks

fabric



NECESSARY:
connectivity between green spaces

performing multiple functions

Austin 2014, page 7

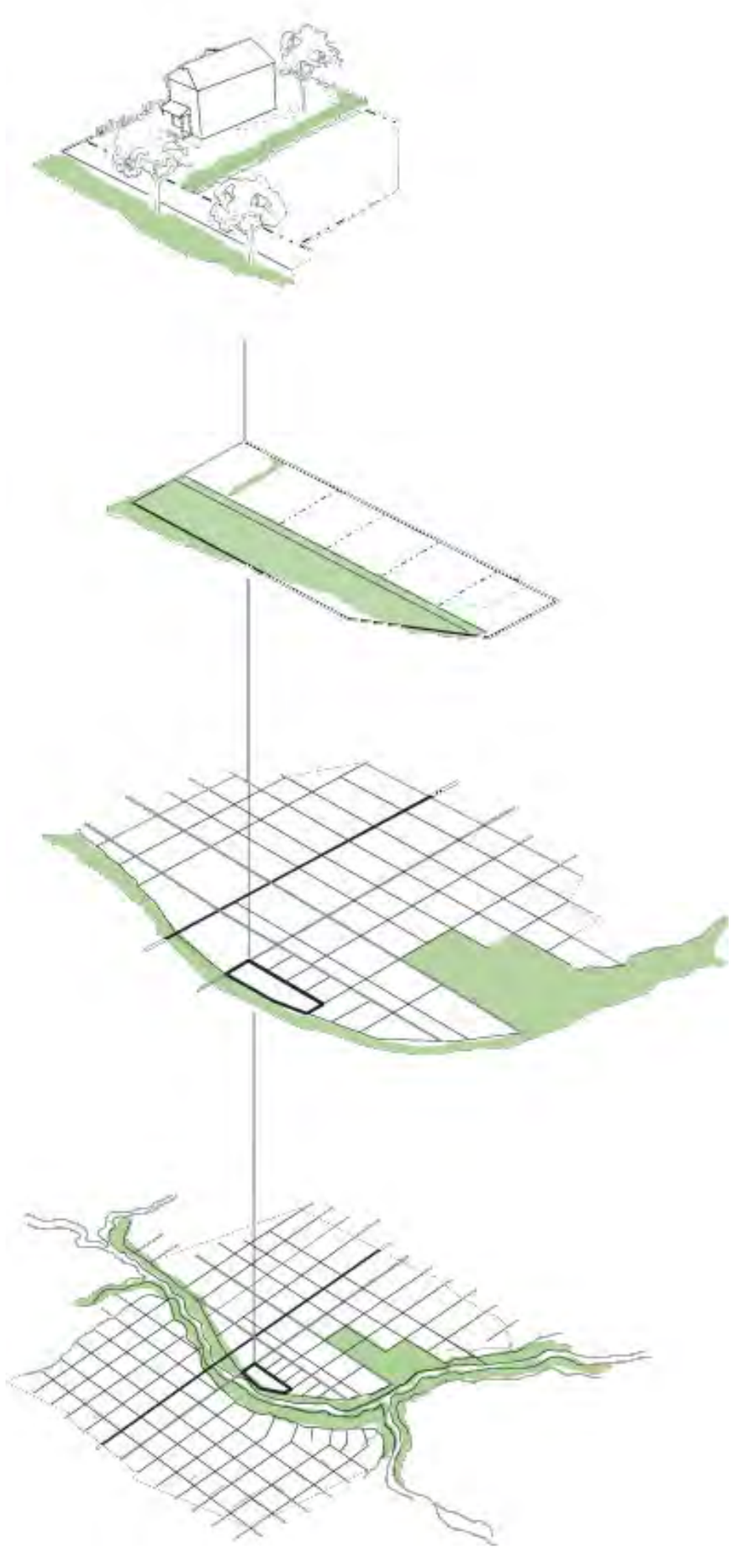
ELEMENTS by SCALE

More human-oriented

More ecosystem-oriented

Lot	Court
	Yard
Block	Play lot
	Common land
	Pocket park
Street	Right of way
	Median
	Planting strip
Neighbourhood	School yard
	Neighbourhood park
	Playground
	Drainage way
Community	Community park
	Play fields
	Greenway
	Golf course
Region	Regional park
	Conservation area
	Rivers, lakes
	Oceans

Girling & Kellett page 58



AUSTIN'S GREEN INFRASTRUCTURE

=

GREEN NETWORKS (this class)

(Green networks + green fabric)

EXCEPT- green infrastructure

performs ecosystem functions

and

provides ecosystem services

A ***PROPOSED DEFINITION*** OF GREEN INFRASTRUCTURE

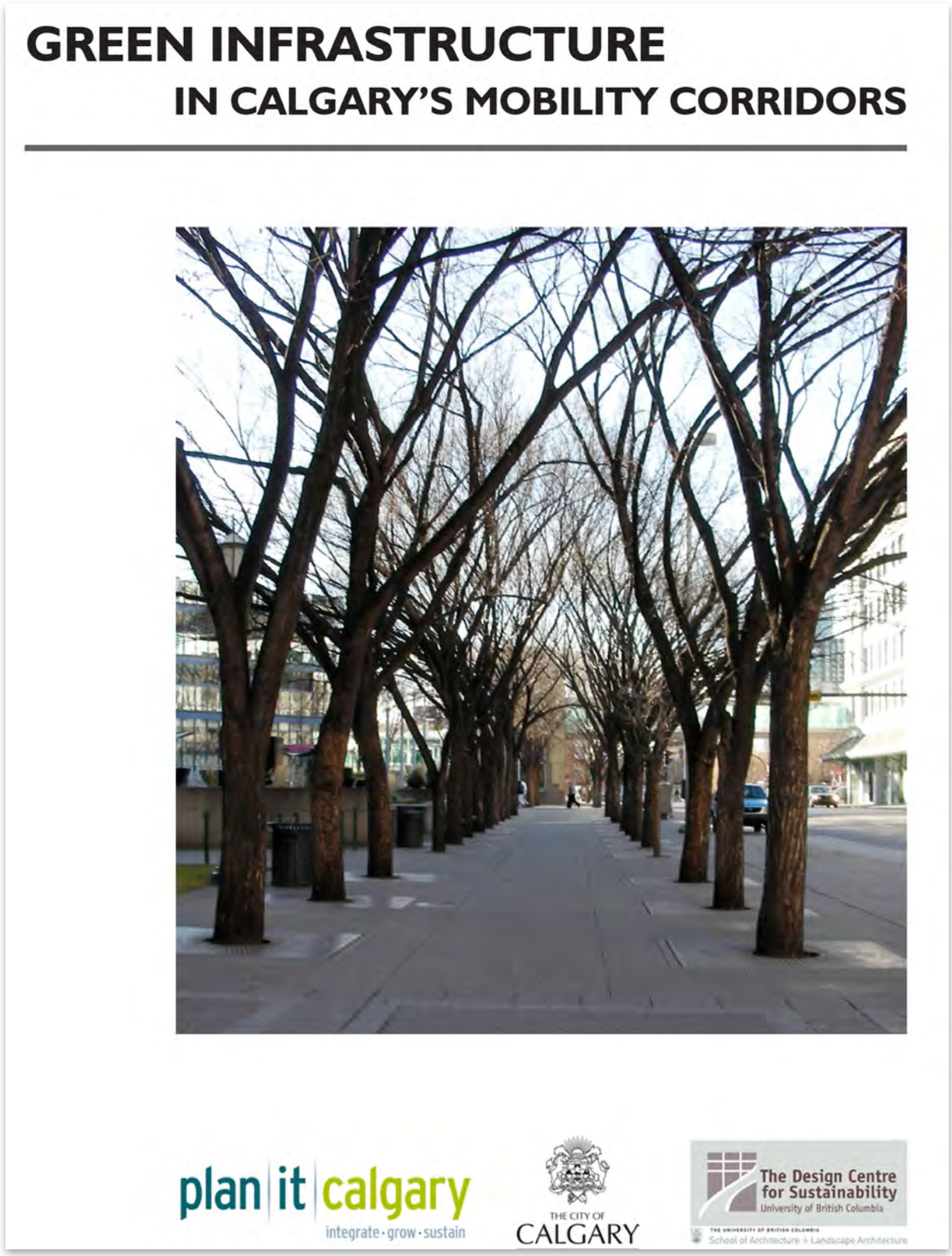
An ***interconnected system*** of urban green spaces that ***perform ecosystem functions*** and ***provide multiple ecosystem services***

W. Morrish 1993, Summary Report

FOCUS: Greening the GRAY INFRASTRUCTURE

CALGARY GREEN INFRASTRUCTURE

Principles and strategies for applying “green infrastructure” to streets and roads



PLAN IT CALGARY 2008

Proposed road and street types

"MOBILITY CORRIDORS"

Through road

Connector street

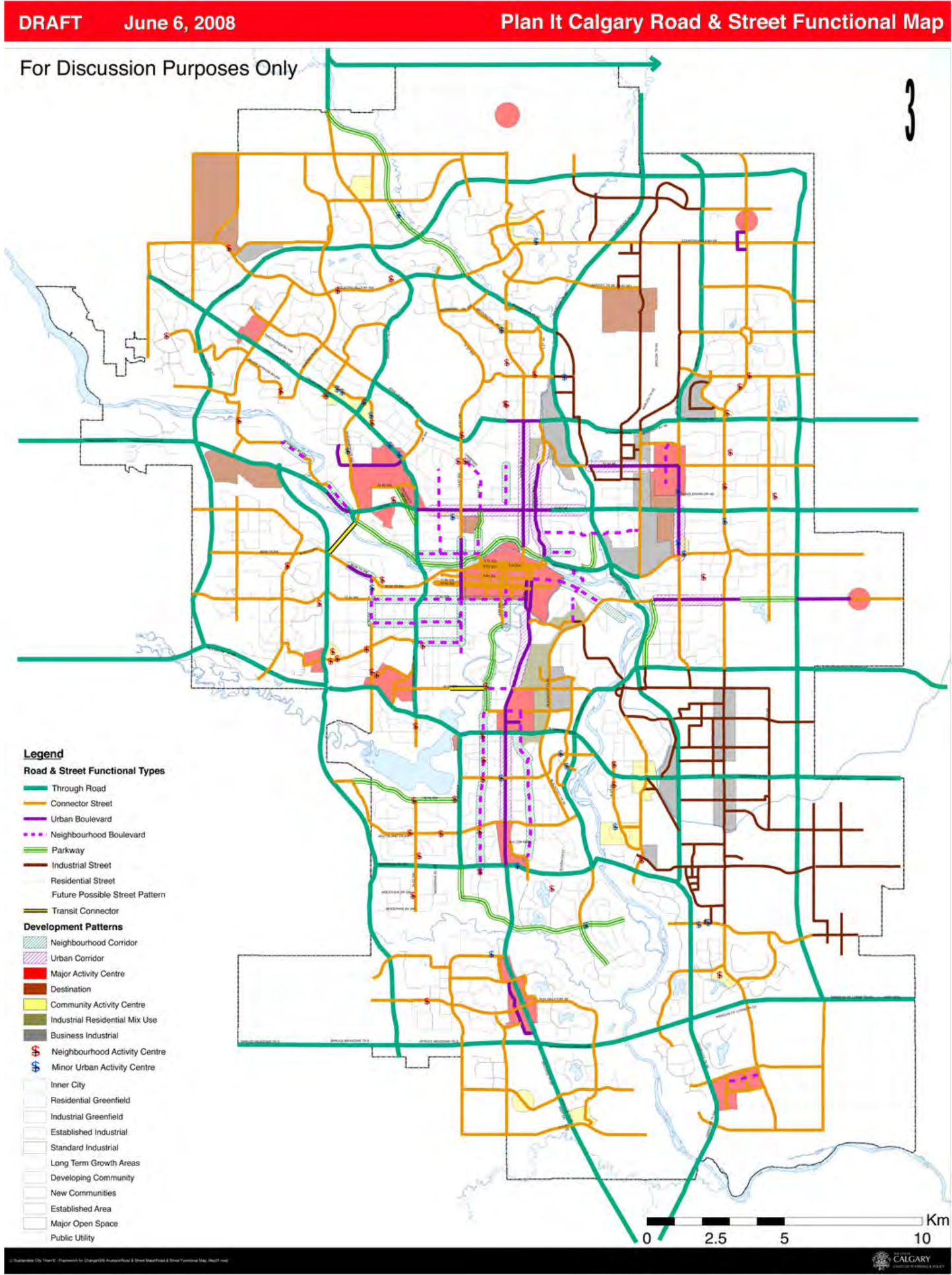
Urban boulevard

Neighbourhood boulevard

Parkway

Industrial street

(Residential streets not included)



GREEN INFRASTRUCTURE PRINCIPLES

AIR Mitigate climate change

WATER Mimic natural hydrology

HABITAT Enhance urban biodiversity

PRINCIPLES & STRATEGIES

AIR:

Mitigate climate change

Accommodate walking and cycling

Enhance the urban forest

Reduce energy demand

WATER:

Mimic natural hydrology →

Maximize on-site infiltration

Reduce effective impervious area

Slow and detain runoff

Filter road runoff

Balance water demand with rainfall

HABITAT:

Enhance urban biodiversity

Preserve, enhance biodiversity

Increase habitat connectivity

Increase the urban tree canopy

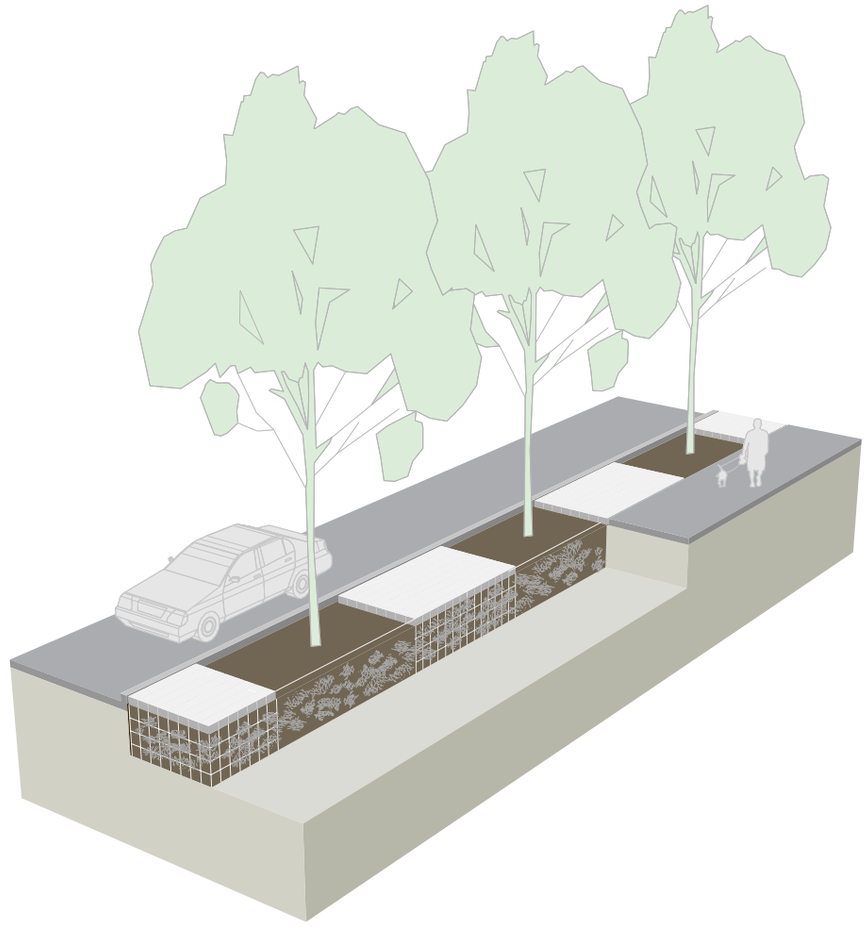
- Vegetated swales
- Infiltration planters
- Infiltration galleries
- Narrower paved areas
- Pervious pavements
- Curb openings
- Flow-through planters
- Rain gardens
- Interception gardens
- Filter strips
- Biofiltration swales
- Stormwater wetlands
- Xeriscaping

AIR: Enhance the urban forest

Maximize tree canopy cover:

Expand the urban forest

Create optimum growth conditions



Calgary: Tree canopy cover = 7% (2008)
7 million trees

Elbow Drive- recently renovated

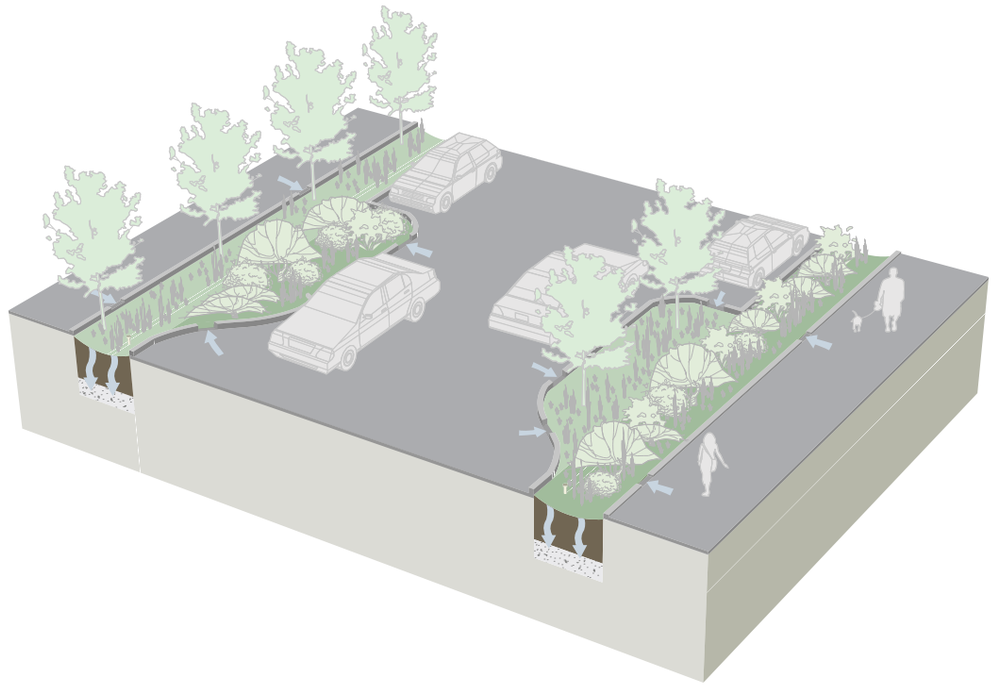
WATER: Mimic natural hydrology

Reduce effective impervious area

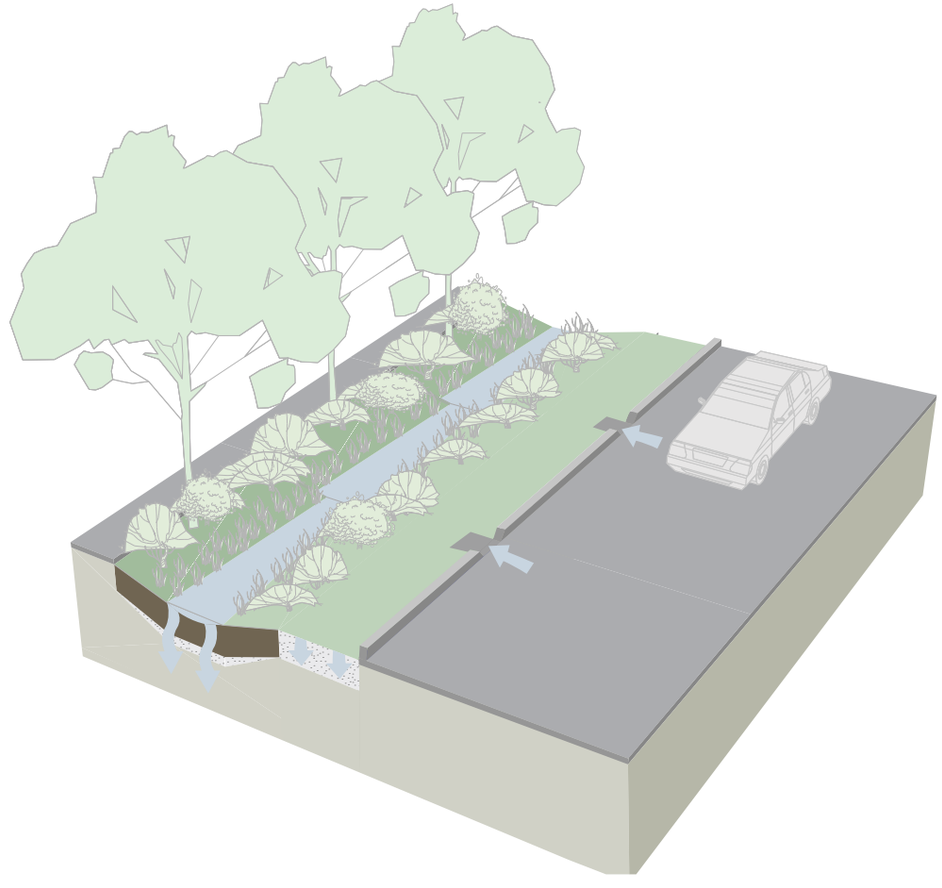
Maximize infiltration

Filter runoff

Detain & infiltrate runoff



Bio-filtration areas in street bulb-outs



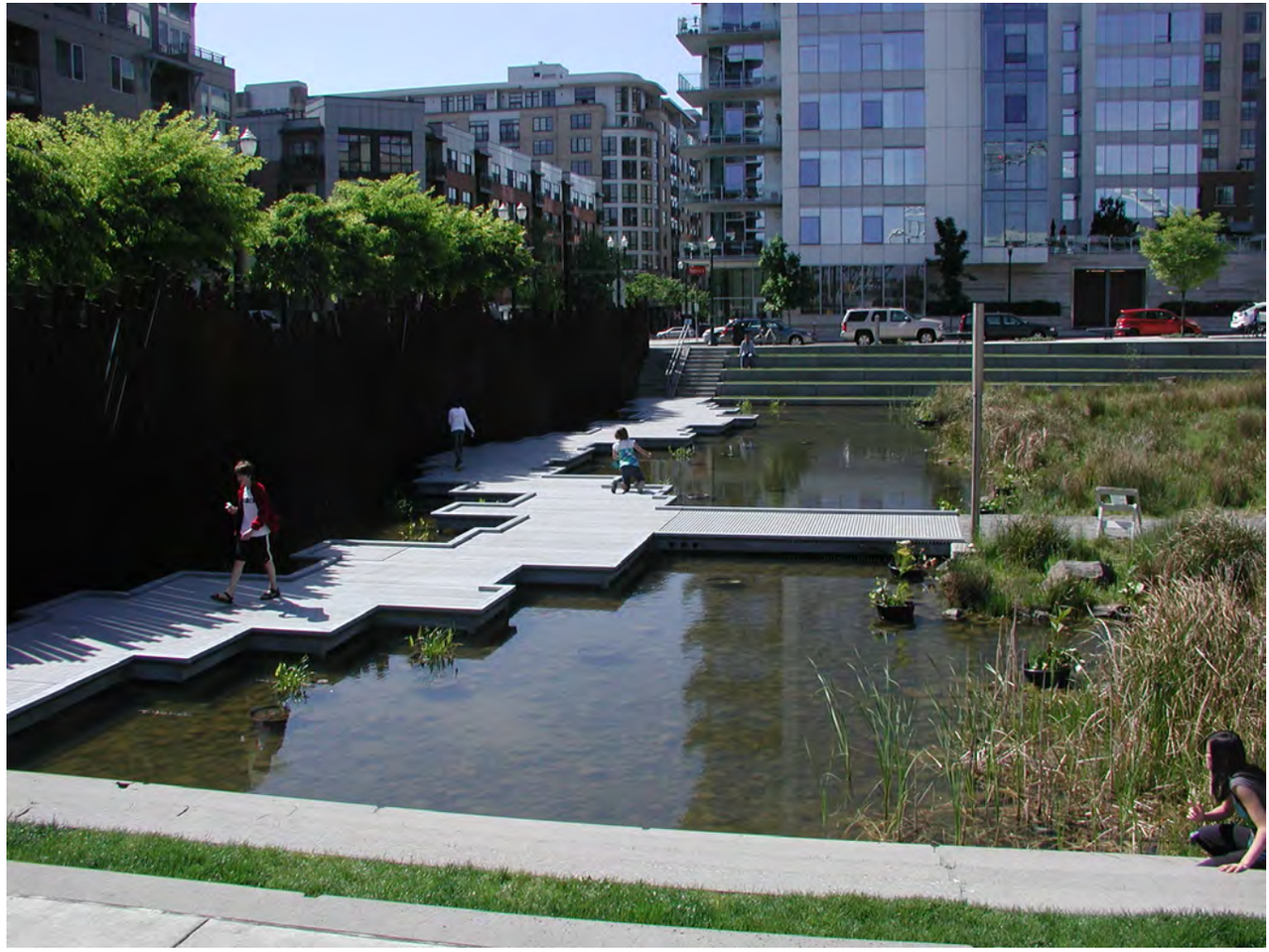
Bio-swale with filter strips

HABITAT: Enhance urban biodiversity

Re-create wetland areas

Use native vegetation

Preserve, enhance biodiversity



Top: Tanner Springs Park, Portland
Elizabeth Carruthers Park, Portland

HABITAT: Enhance urban biodiversity

Increase the urban tree canopy

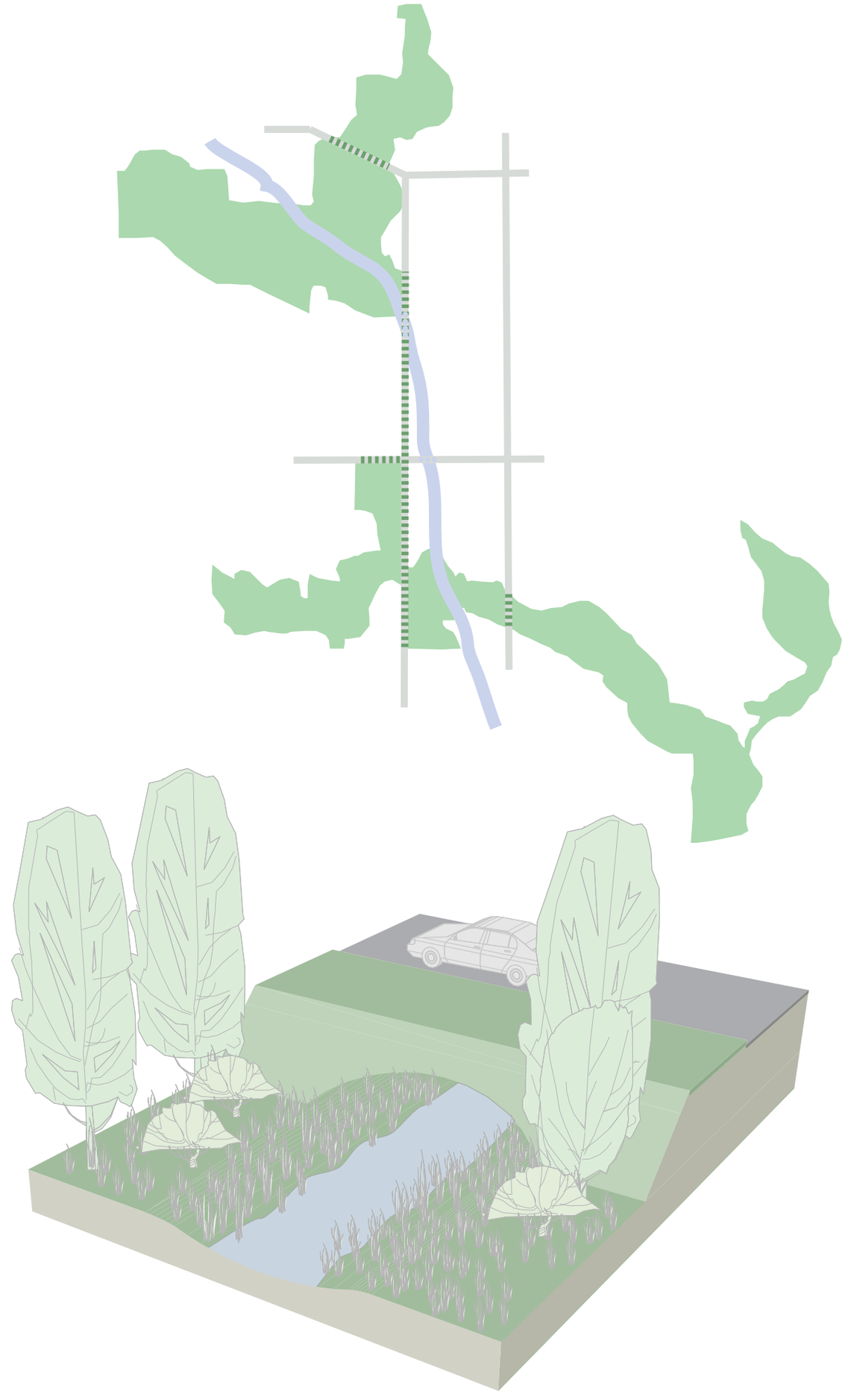
(Increase tree diversity)

Top: Seaside Greenway at Olympic Village 2008
Bottom: Same location 2016

HABITAT: Enhance urban biodiversity

Increase habitat connectivity

Bridge over streams

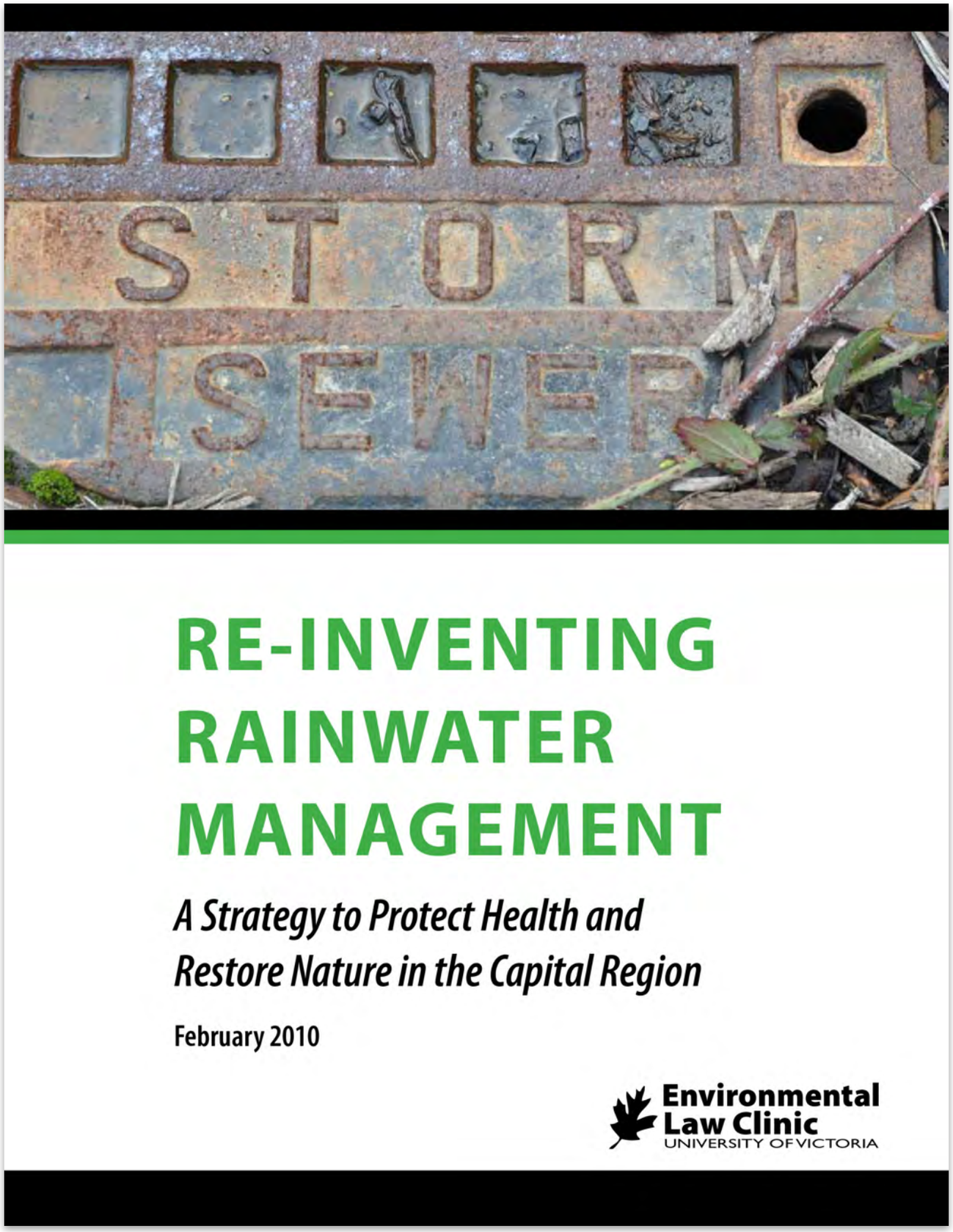


RAINWATER NOT STORMWATER!

RAINWATER NOT STORMWATER!

A paradigm shift:
from managing STORMwater to
managing RAINwater

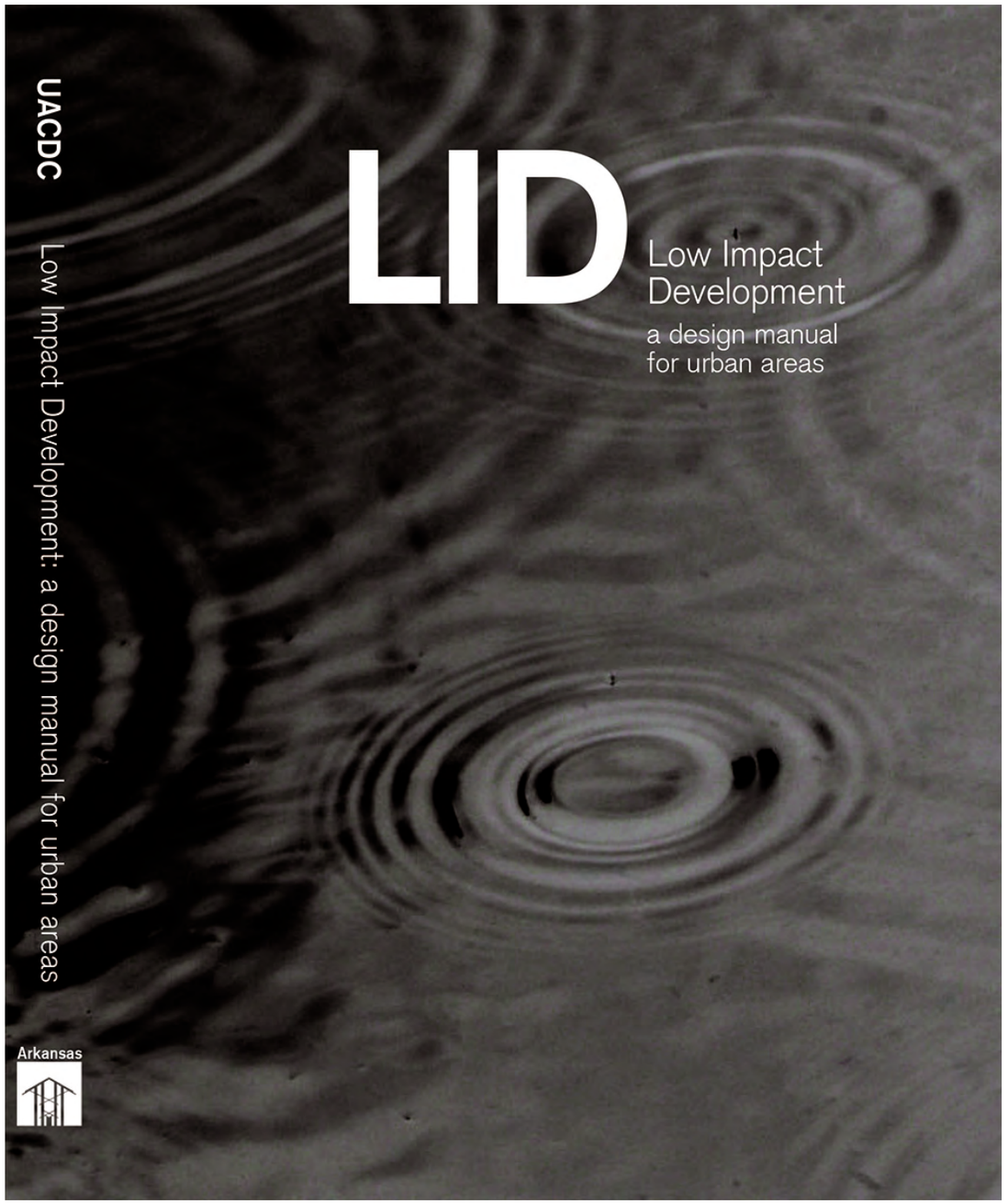
interdisciplinary
ecosystem oriented
water as a resource



University of Victoria
Environmental Law Clinic 2010

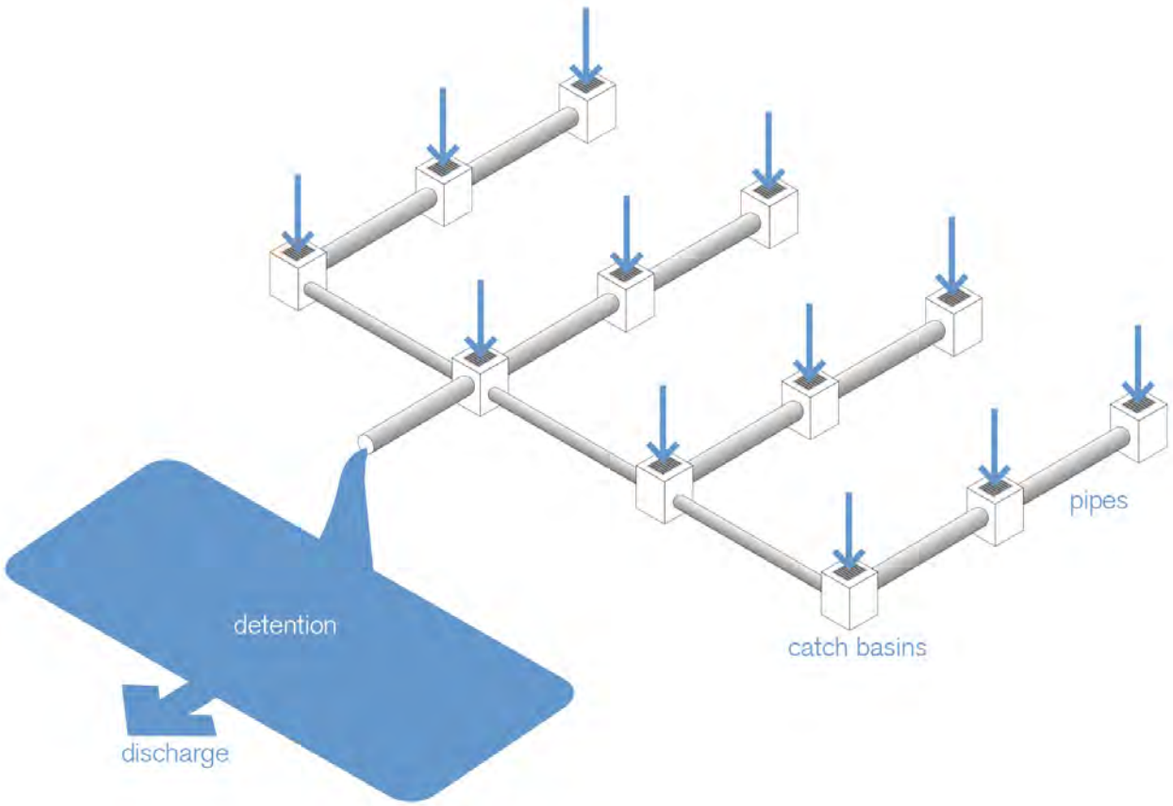
Low Impact Development a design manual for urban areas

University of Arkansas Community Design Center (UACDC) 2010



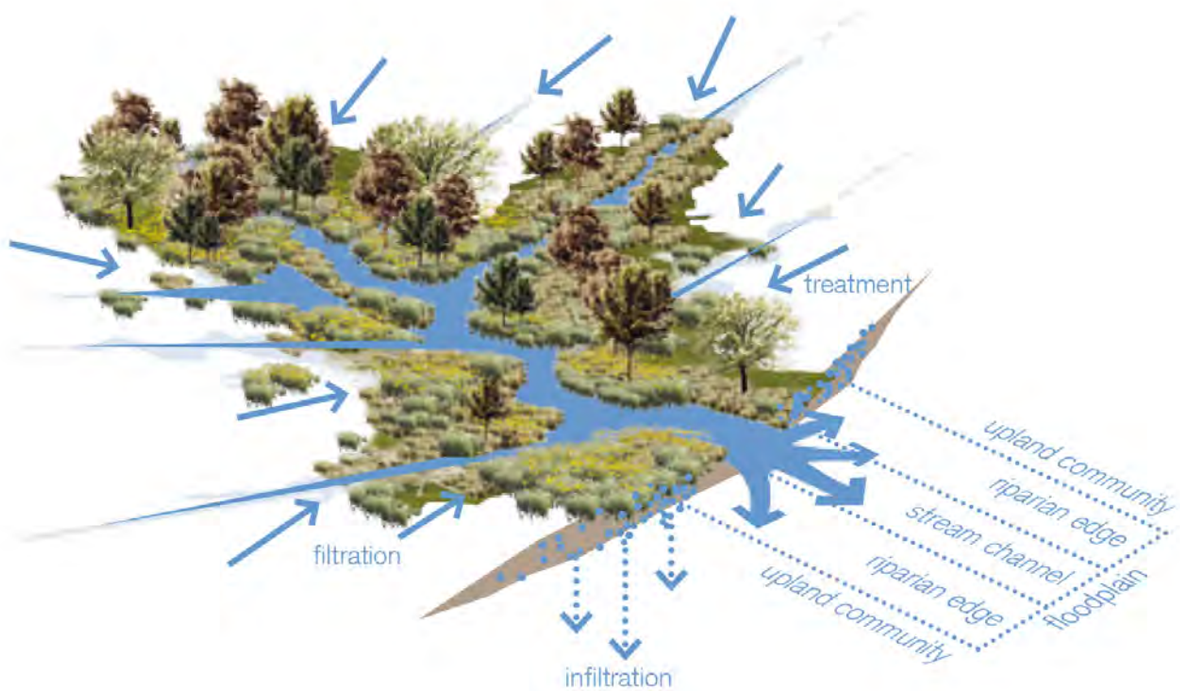
LID (low impact development)
aka green infrastructure
aka soft engineering

hard engineering
...just transfers pollution
to another site



conventional management: "pipe-and-pond" infrastructure
drain, direct, dispatch

soft engineering
...metabolizes pollutants
on site—parks, not pipes!



low impact management: watershed approach
slow, spread, soak

hard engineering

mechanical

A catch basin is part of a stormwater management system designed to trap debris and sediment before it enters a pipe network.

polluted runoff

polluted runoff

pollutants
bacteria
petroleum-based products
sediment
heavy metal
fertilizer

output

input

soft engineering

biological

Phytoremediation is the mitigation of contaminated soil, water, or air using plants to contain, degrade, or eliminate pollutants.

phytovolatilization
process where plants uptake contaminants and release them into the atmosphere as they transpire

absorbed as nutrients

polluted runoff

uptake

phytoextraction
using plants to remove pollutants from soils, sediment, or water into harvestable plant biomass

root storage

biochemical breakdown

phytodegradation
metabolic process that breaks down or degrades contaminants into simpler molecules or elements

phytostabilization
sequestration of contaminants in the soil through absorption or accumulation around the root zone

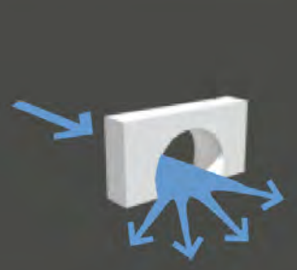
GI FUNCTIONS: Mimic natural hydrology

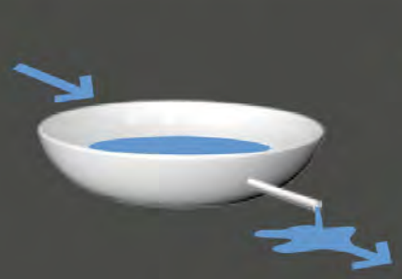


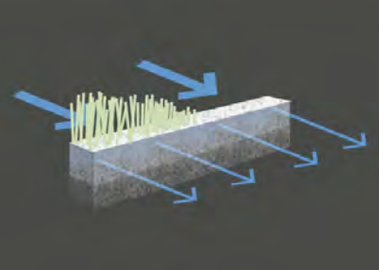


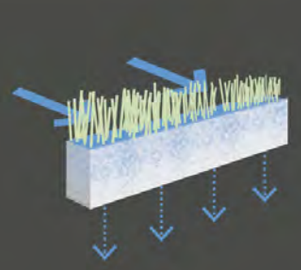

mechanical

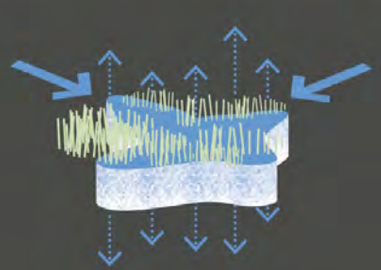
biological











slow → spread → soak

flow control: The regulation of stormwater runoff flow rates.

detention: The temporary storage of stormwater runoff in underground vaults, ponds, or depressed areas to allow for metered discharge that reduce peak flow rates.

retention: The storage of stormwater runoff on site to allow for sedimentation of suspended solids.

filtration: The sequestration of sediment from stormwater runoff through a porous media such as sand, a fibrous root system, or a man-made filter.

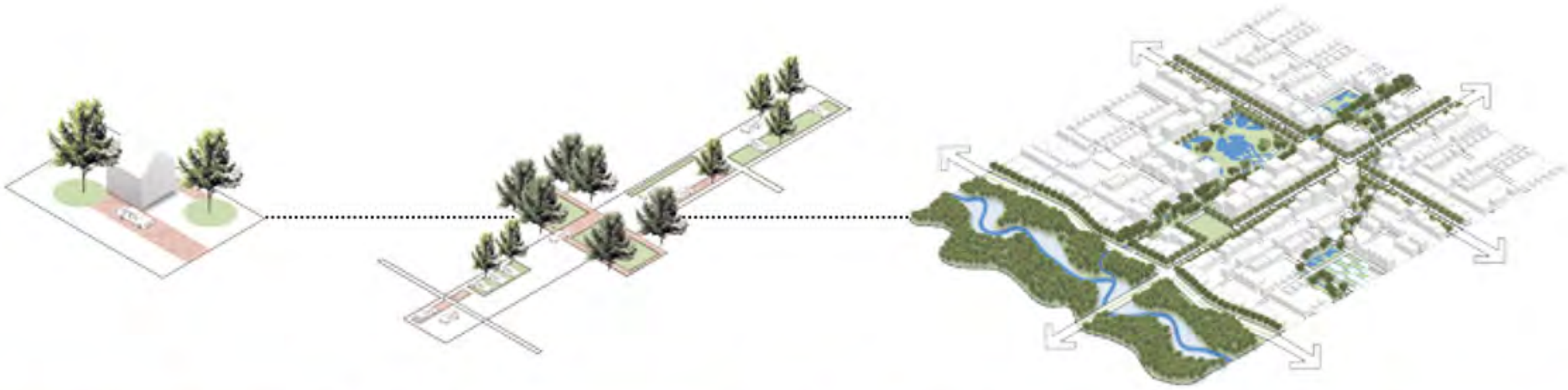
infiltration: The vertical movement of stormwater runoff through soil, recharging groundwater.

treatment: Processes that utilize phytoremediation or bacterial colonies to metabolize contaminants in stormwater runoff.

detain retain filter infiltrate treat

SLOW → SPREAD → SOAK

Interconnected systems across scales



lots: LID lots infiltrate stormwater through reduction or elimination of impervious surfaces and replacement of turf grass with productive landscapes.

streets: LID streets are green streets reducing and filtering runoff as it enters public space while enhancing the quality of place.

networks: LID networks contain treatment facilities connected to regionally scaled systems of stormwater management.

Street Types

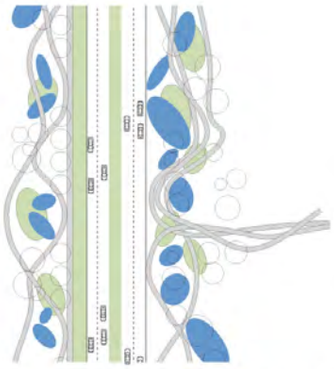
skinny streets

green streets

shared streets

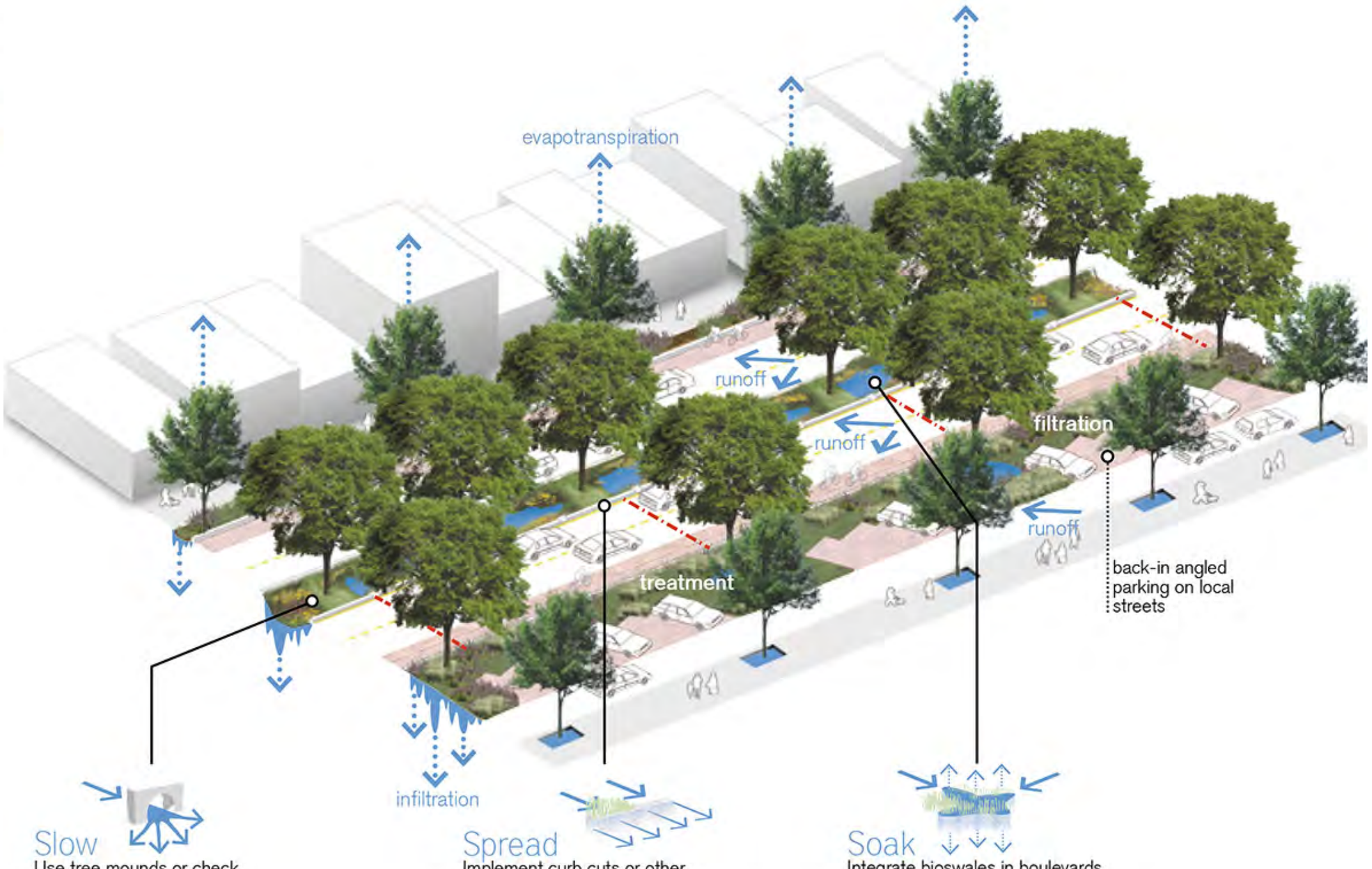
eco-boulevards

parkways



from local streets → to arterial streets

Eco-boulevards



Slow

Use tree mounds or check dams in medians to attenuate and detain runoff, allowing stormwater a chance to infiltrate during **one to ten-year storm events**. *Flow Control Devices* pp. 148-149

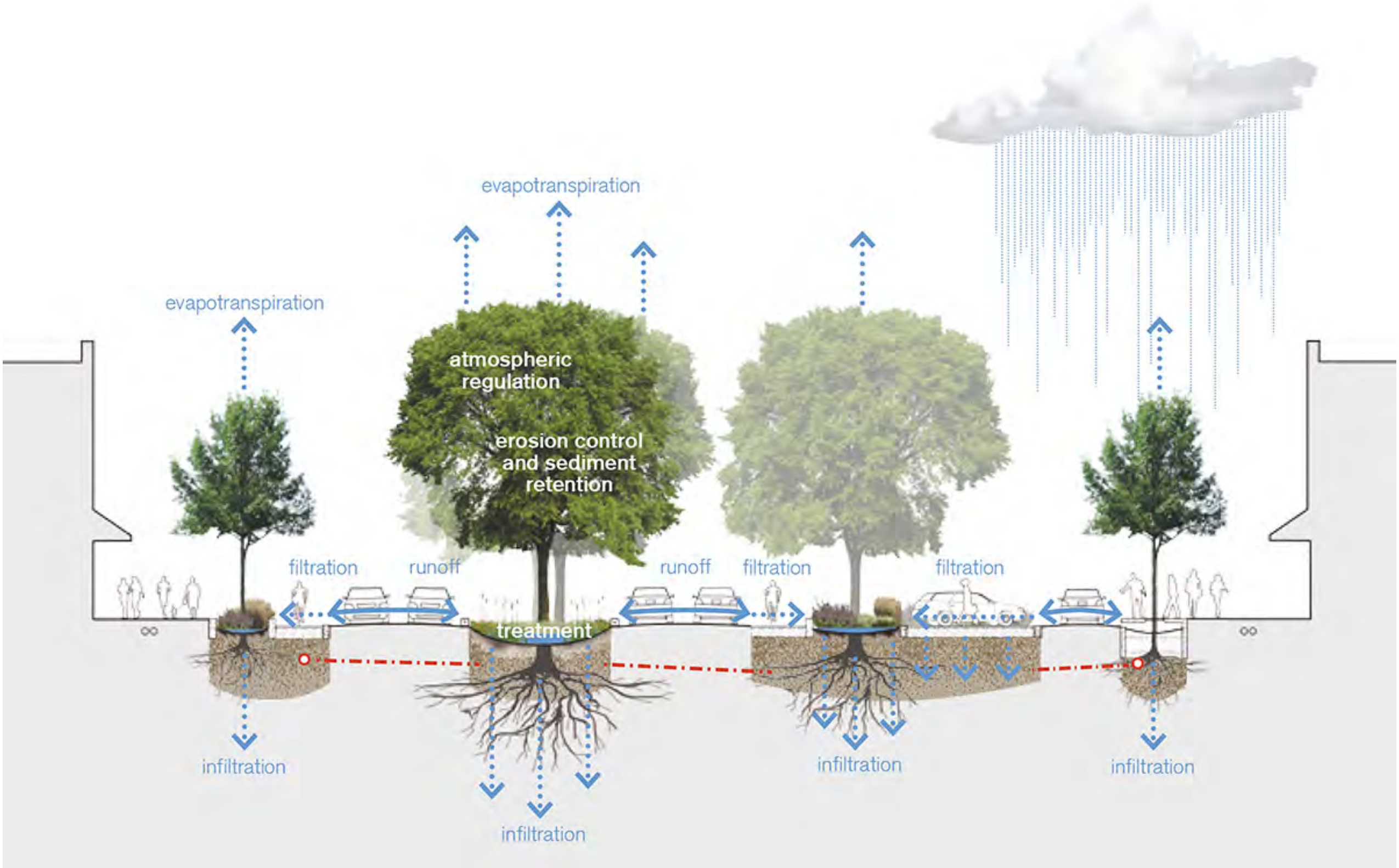
Spread

Implement curb cuts or other curbing strategies to allow water to flow into median LID facilities. *Curb Alternatives* pp. 96-97

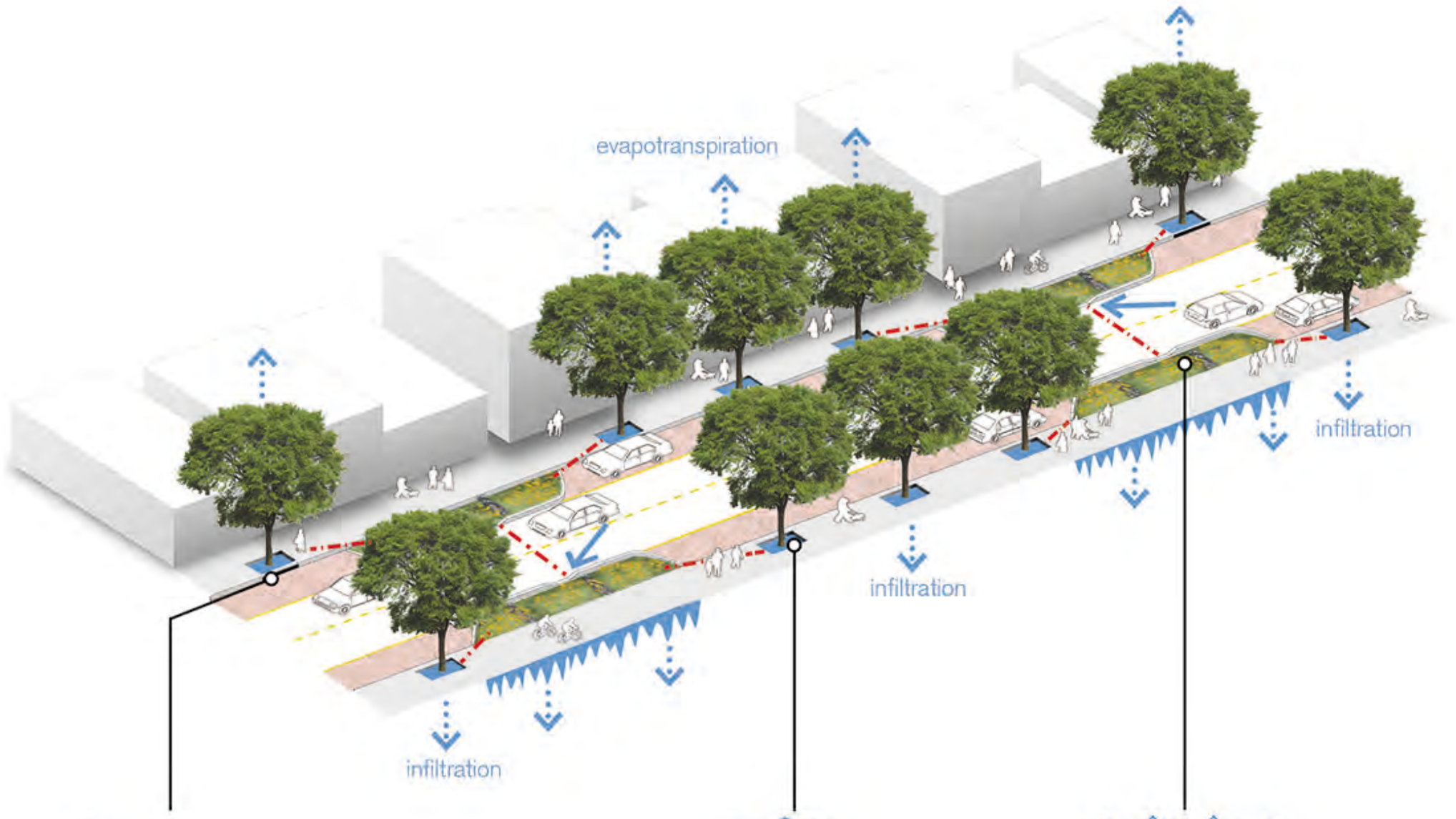
Soak

Integrate bioswales in boulevards to treat stormwater runoff before it enters conventional systems during **10 to 50-year storm events**. *Bioswale* pp. 182-183

Eco-boulevards



Skinny Streets



Slow

Cut curbs to allow for stormwater flow into curb extensions or other LID facilities. *Flow Control Devices* pp. 148-149

Spread

Construct tree box filters along the right-of-way to filter and attenuate stormwater runoff during **one to two-year storm events**. Connect in a series or to rain gardens using perforated pipe to handle larger events. *Tree Box Filter* pp. 176-177

Soak

Use curb extensions to retrofit existing parking lanes with rain gardens. This reduces impervious surface area, and encourages infiltration during **10 to 25-year storm events**. *Rain Garden* pp. 178-179

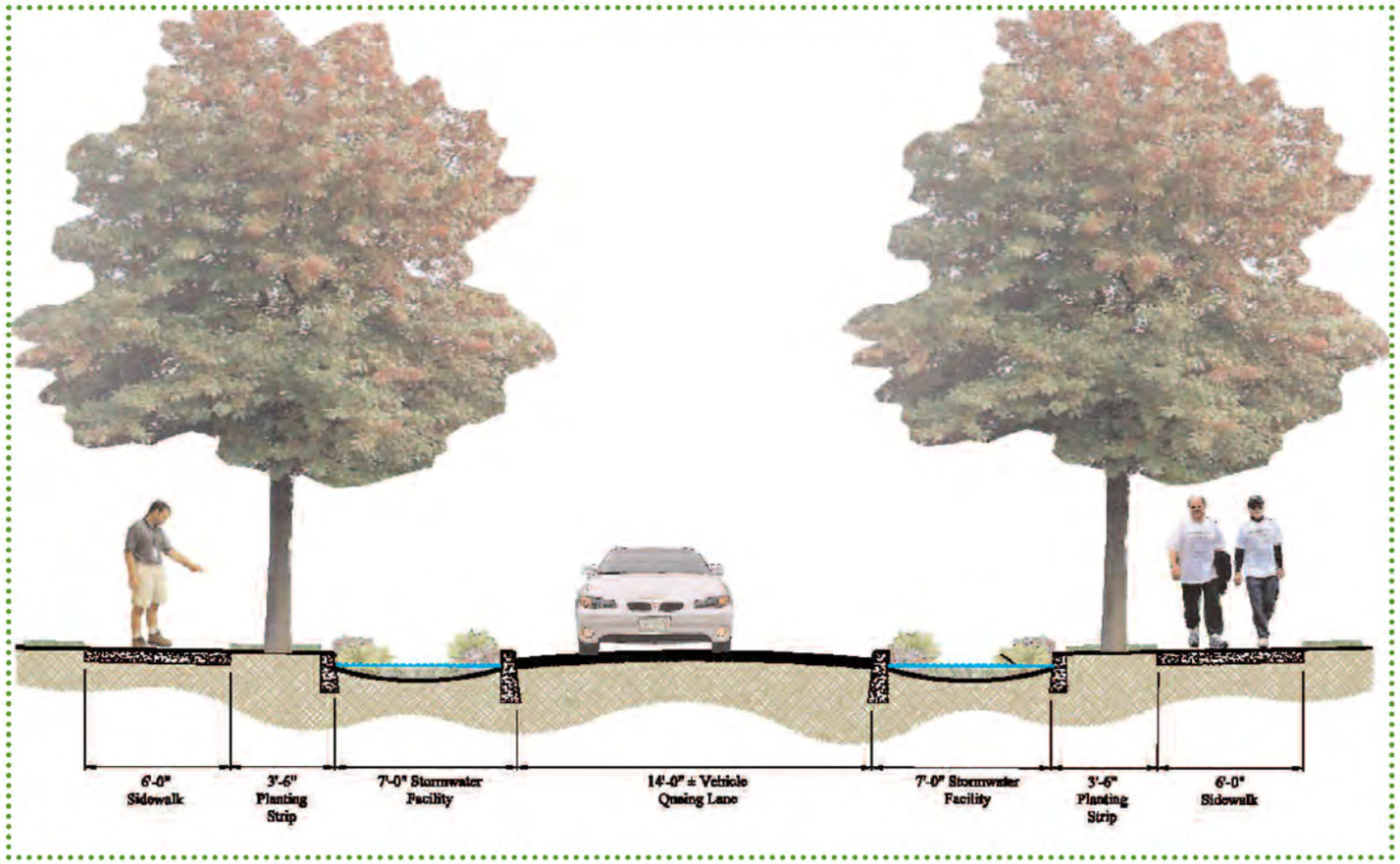
NE Siskiyou Green Street, Portland

PORTLAND GREEN STREETS

SMALL RAIN GARDENS-

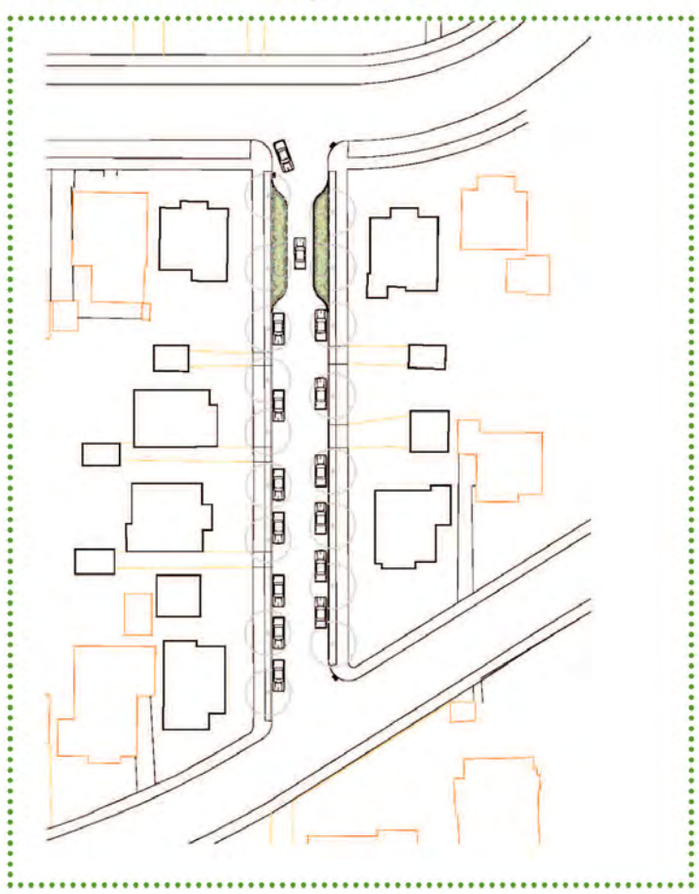
- collect and filter street runoff
- protect and improve the grey infrastructure
- prevent sewer combined sewer overflows (CSOs)
- increase urban green space
- improve air quality
- replenish groundwater
- reduce air temperature

NE Siskiyou Green Street



▲ Typical Section of NE Siskiyou Street

▼ Plan view of NE Siskiyou Street



Stormwater slows as it enters the landscape area, water soaks into the ground, and wetland plants filter pollutants. ▼

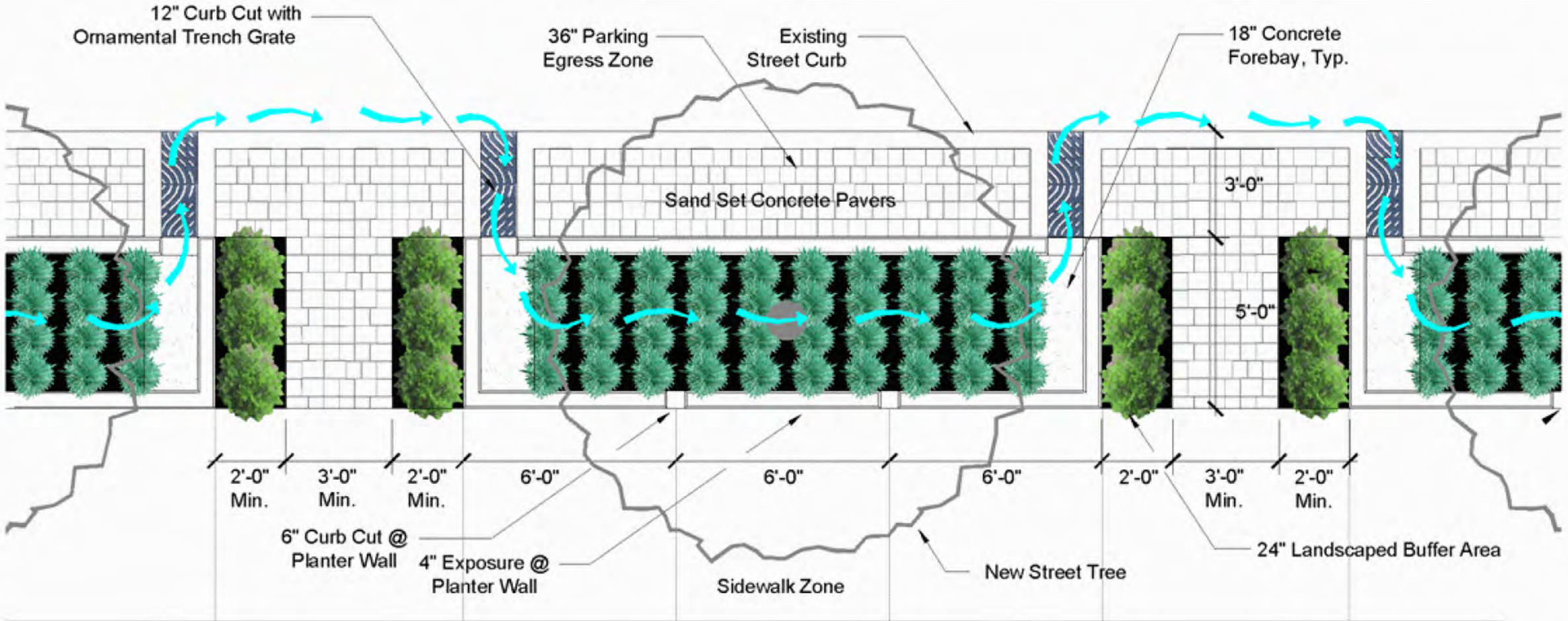
Printed on recycled paper. PL 0508 revised Jan 2005

Siskiyou Street
Portland, Oregon

SW 12TH AVENUE, PORTLAND

drains 7500 sq ft street

reduces peak flow from 25 yr rain event by 70%



SW MONTGOMERY STREET, PORTLAND

Nevue Ngan Landscape Architects, Portland 2012 ASLA Award

SW MONTGOMERY STREET, PORTLAND

The "Stormwater Spine"

SW Montgomery Green Street

Connecting the West Hills to the Willamette River

1 Stormwater Bridges

Multiple pedestrian bridges across the stormwater spine are needed to provide adequate pedestrian flow throughout the corridor. These bridges should be wide enough and spaced frequently to accommodate specific users such as bikes, people, and even autos.

2 "Curbless" Street Profile

Providing a flush drainage condition along the stormwater spine allows stormwater runoff to sheet flow into the landscape area. This provides both a barrier free condition for pedestrians and a shallower and more aesthetic stormwater facility.

3 High-Density Planting

The stormwater spine is a functional landscape area used to clean and absorb stormwater runoff. Providing a high-density spacing of trees, shrubs, and groundcovers maximizes the ability for plant roots to clean pollutants and absorb runoff.

4 Simple and Shallow

There is a maximum grade change of 6-inches from the walking surface to the finish grade of the stormwater spine. This simple design approach eliminates the typical need for a perimeter curb around the landscape and still allows for adequate pedestrian safety.

5 A Continuous Theme

The stormwater spine functionally and visually links individual blocks within the street corridor. Planting types and the width of the spine does vary from block-to-block in response to unique conditions. However, the overall "green thread" remains consistent throughout.

SW MONTGOMERY STREET, PORTLAND

SW 10TH AVENUE TO SW 9TH AVENUE

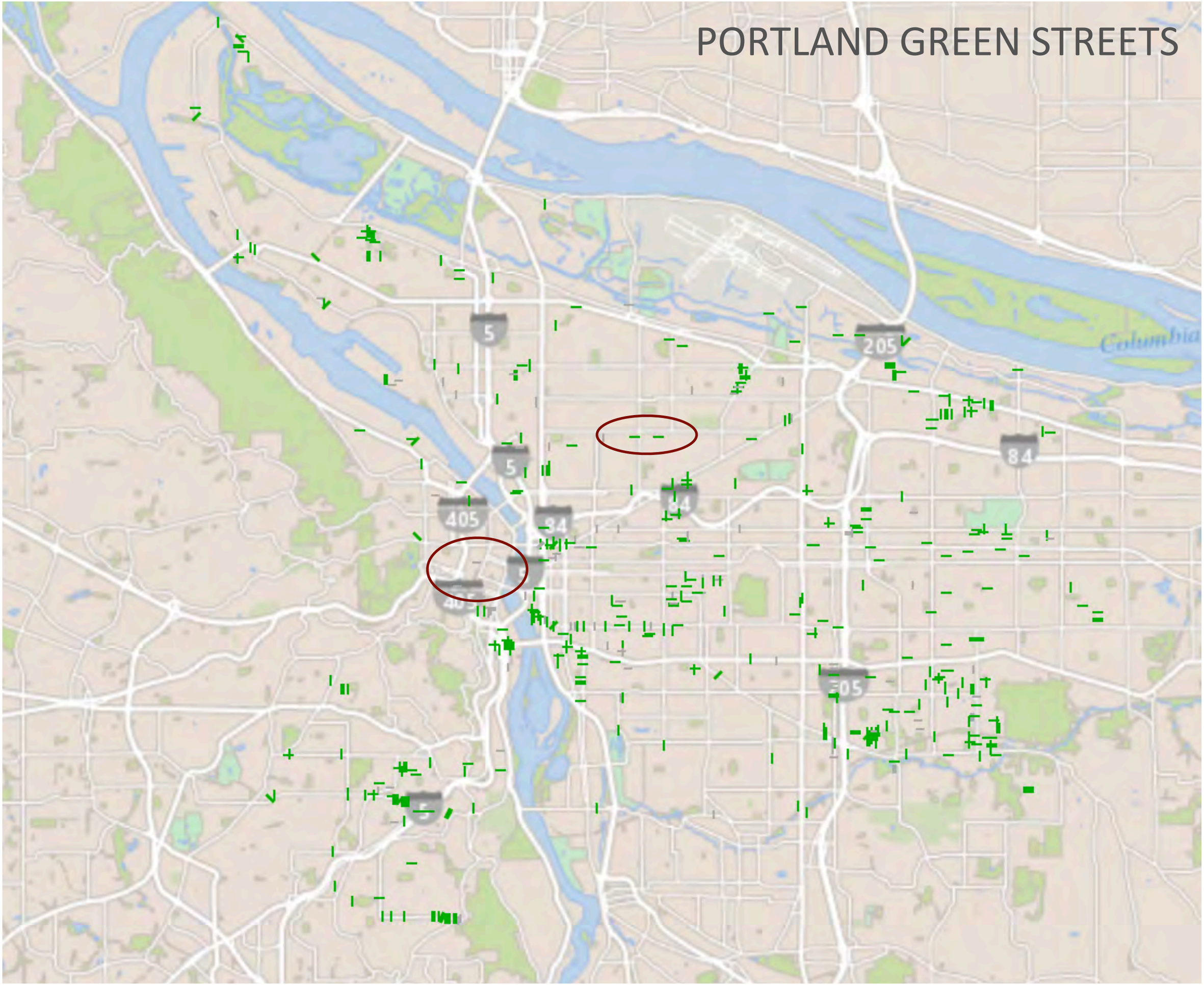
SOURCE: NEVUE NGAN ASSOCIATES

Water moves through a pedestrian-only Main Street in Aspen, Colorado.

The green street between SW 10th and SW 9th Avenues responds to the primarily residential condition with a woonerf-inspired form. This type of street, often referred to as a "Living Street", prioritizes public space for pedestrians and cyclists over the use of cars. The street level has been raised to curb height and the paving extends right up to the apartment buildings, blurring the line between public and private, between street and sidewalk. This creates a responsive space that can change through time to reflect the needs of the users. The existing pull-through vehicular space is now shared with pedestrians to become a courtyard for the existing housing and ground floor restaurants. Pedestrian uses can expand or contract, introducing furniture and plants into this realm, asking cars to slow down and find their own way through the space. This block establishes the line the stormwater will travel as it moves toward the river. The curbless street simply sheds water into the slightly recessed stormwater spine and leaves a large, flexible ground plane. In addition to a lane of parallel parking, cars are provided a single west-bound travel lane defined by bollards while allowing pedestrians and bicyclists free to move across the entire space.

SOURCE: NEVUE NGAN ASSOCIATES

PORTLAND GREEN STREETS



VANCOUVER **RAINWATER** PLAN

Rain City Strategy
vancouver.ca/raincity

*“Capture and treat **90%** of rain falling on Vancouver”*

Melina Scholefield
Rain City Team

https://www.youtube.com/watch?v=3BqQ_KvMeGM

VANCOUVER RAINWATER PLAN

VISION:

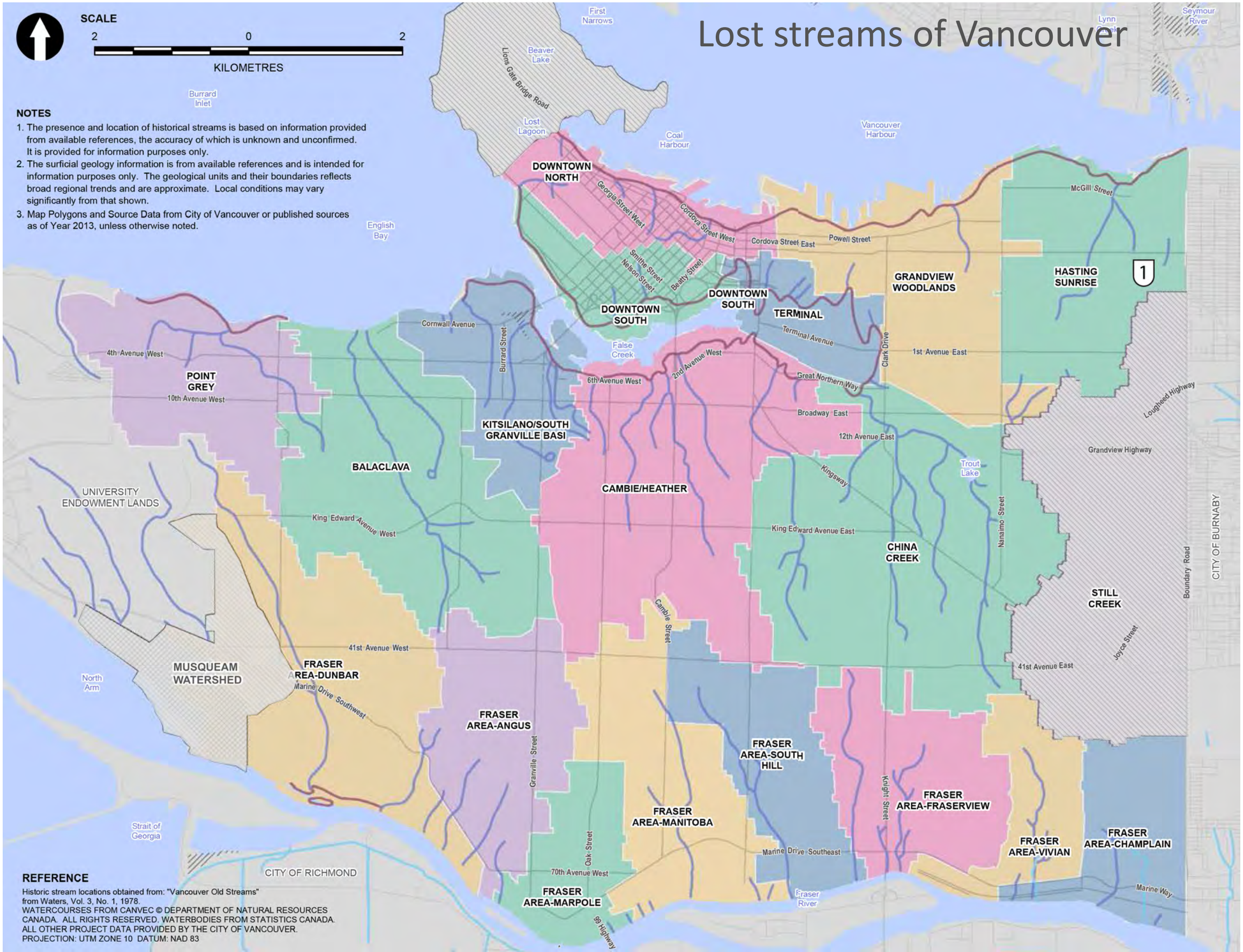
- Celebrate Vancouver's abundant rainwater as a resource

- Maintain clean water from watersheds to receiving waters

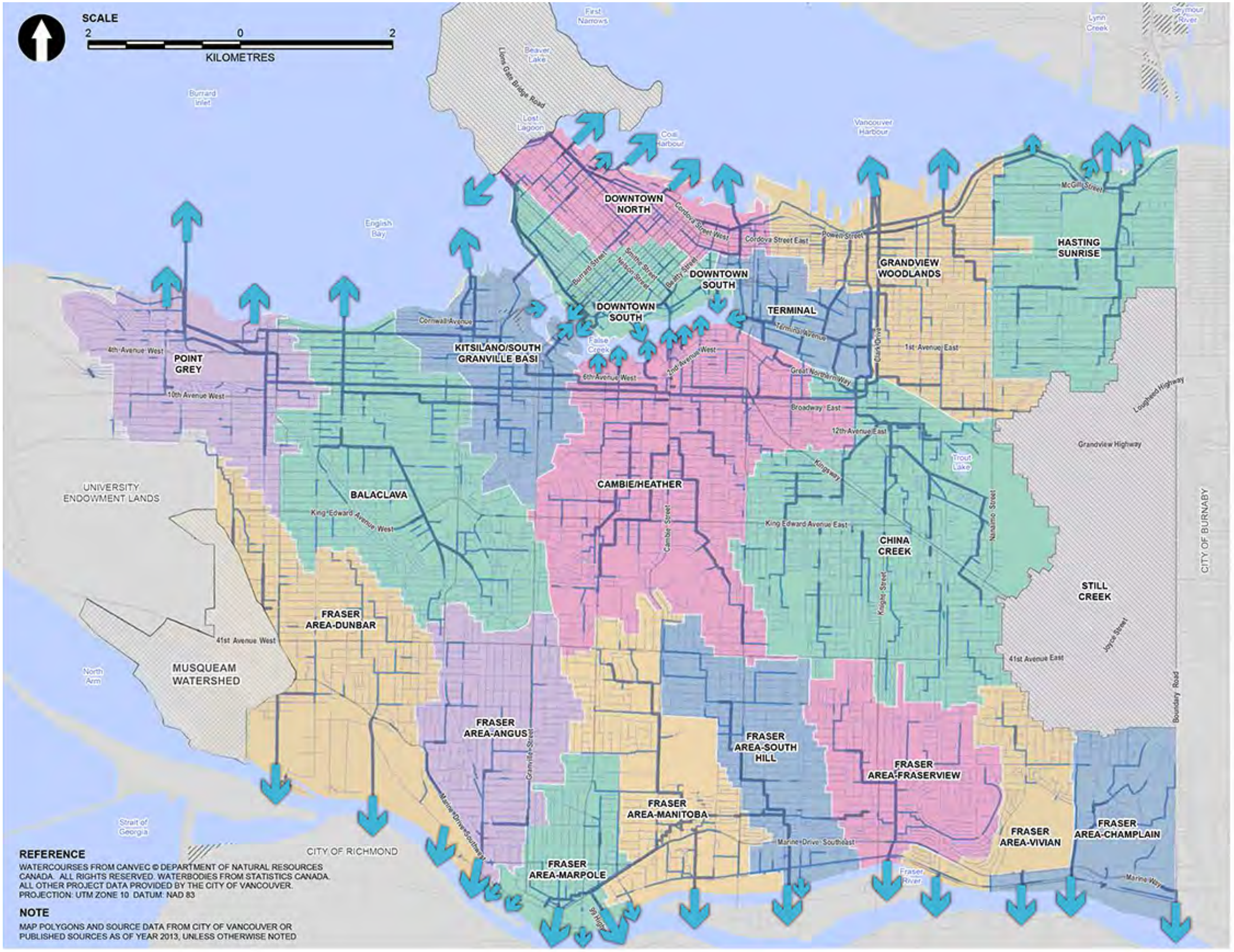
- Reduce potable water demand

- Restore urban watersheds to support urban and natural ecosystem functions

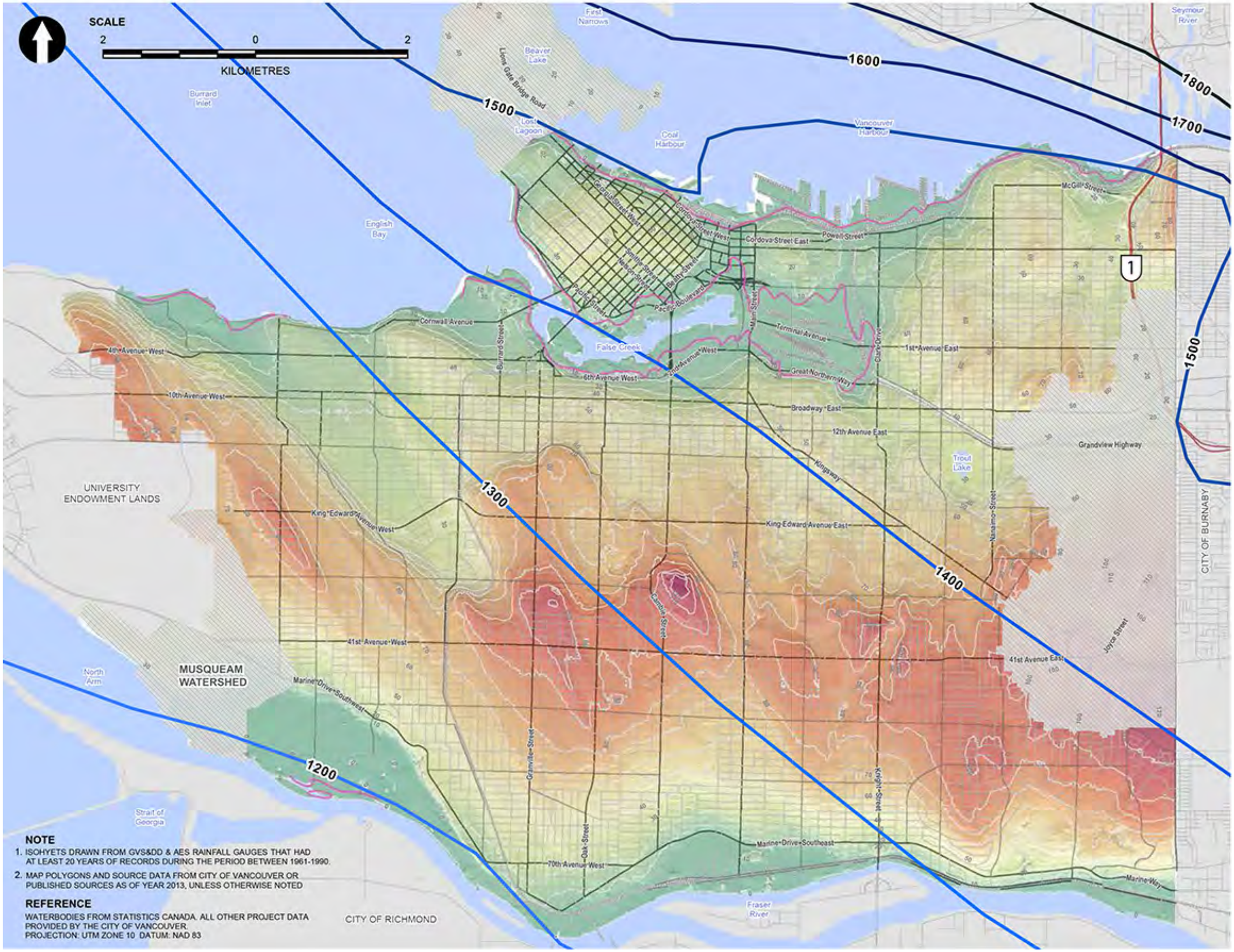
WATER/HYDROLOGY



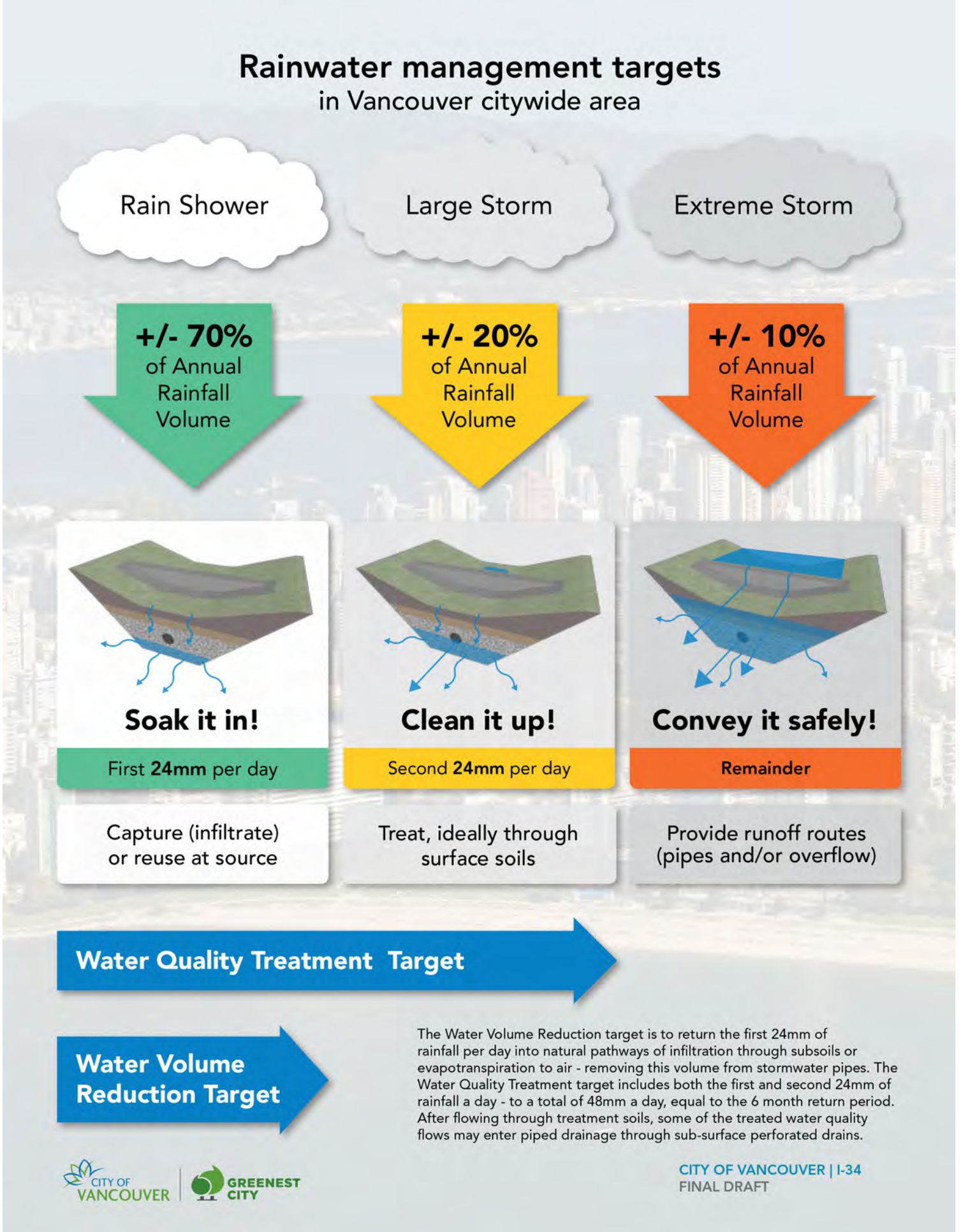
WATER/HYDROLOGY



TOPOGRAPHY & RAINFALL



Capture and treat ***90%***

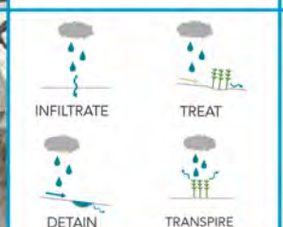


VANCOUVER GI TOOLS

Green Infrastructure Tools for Rainwater Management

The summary matrix below introduces a range of Green Infrastructure practices to improve rainwater management. These tools are in common use in other jurisdictions around Metro Vancouver, the Pacific Northwest, and in developed areas around the world.

For more information on Green Infrastructure, see the BMP Toolkit (IRMP Volume II)

TOOL		IMPACTS ON WATER	BENEFITS
Absorbent Landscapes			• intercept and clean rainwater through soil pores, allowing gradual infiltration into subsoils to recharge groundwater
Infiltration Swales			• reduce runoff volume and increase water quality by capturing, detaining, treating, and conveying stormwater
Rain Gardens & Infiltration Bulges			• reduce runoff volume and improve water quality by infiltrating, capturing, and filtering stormwater • an overflow conveys extreme rainfall volumes
Pervious Paving			• reduce runoff volume and improve water quality by infiltrating and treating stormwater while still providing a hard, drivable surface
Green Roofs			• reduce stormwater peak flows and volume, depending on depth of growing medium • benefit buildings by providing insulation and by reducing the heat island effect • provide urban habitat
Tree Well Structures			• adequate soil volume will retain excess stormwater and help to remove pollutants from stormwater runoff • support a healthy tree canopy which intercepts rainfall

TOOL		IMPACTS ON WATER	BENEFITS
Rainwater Harvesting			• runoff from roof surfaces can be captured, stored and used for non-potable uses like landscape irrigation, laundry, and toilets, subject to approval of authorities having jurisdiction.
Infiltration Trenches			• reduce the volume and rate of runoff by holding and infiltrating water into subsurface soils • water quality pre-treatment is advisable
Water Quality Structures			• capture petroleum hydrocarbons, coarse grit and coarse sediment • provide some water quality benefits except for soluble nutrients and pollutants
Detention Tanks			• reduce flooding and in-stream erosion by collecting and storing stormwater runoff during a storm event, and releasing it at controlled rates to the downstream drainage system
Daylighted Streams & Channel Improvements			• may provide in-stream detention, water quality improvements, and essential habitat for aquatic life • contribute to the liveability of an area and establish a sense of place if properly designed
Constructed Wetlands			• provide detention, storage, habitat, and treat stormwater runoff through natural processes prior to discharging it into the downstream drainage system

Pennoyer Green Street, Portland, OR

TAKE-AWAYS:

- RAINWATER not stormwater
- Rainwater is a resource (not waste)
- Green infrastructure = green networks…except
- GI performs ecosystem functions - i.e. mimics
- GI offers multiple ecosystem services
- Different GI tools are suited to different urban conditions
- Interconnectivity is important to functioning

QUESTIONS?

COMMENTS?