Development of a Decision Support Tool for Evaluation of Urban Water System Metabolism Efficiency

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1 | REVITALIZATION OF TORONTO'S WATEFRONT

Toronto Waterfront in 2038

IWRET Integrated Water Resources Evaluation Tool

2 | EXPANDING SUSTAINABILITY FRAMEWORK

THE STAR

Star Business Journal

Scooch over: Toronto has room for more density, study says

By TESS KALINOWSKI Real Estate Reporter
Tues., Jan. 9, 2018

Slow-moving roads, the subway squish and mushrooming skyscrapers might be the most obviously irksome signs of Toronto's growing population density.

But there's still plenty of room for more people in The Six before it approaches the top of a list of 30 high-income, international cities, says a study by the Fraser Institute being released Tuesday.

A Fraser Institute report found that there are 4,457 inhabitants per square kilometre in Toronto, compared to just over 11,000 in London and New York. (RENÉ JOHNSTON / TORONTO STAR FILE PHOTO)

THE STAR

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News · GTA

Race is on to build the tallest Toronto highrise

By MAY WARREN StarMetro Toronto
Wed., July 18, 2018

As plans progress for a massive change at the waterfront, competition for the title of Toronto's tallest building (after the CN tower) is heating up.

A 95-storey building is planned for the Pinnacle 1 Yonge site, which is marketed to be the tallest in the city. At 307 metres high, according to site plans submitted in June to the city's development web portal, the proposed highrise would edge out First Canadian Place, which currently holds the honour.

NATIONAL POST

Canada Census 2016: Toronto growth well above the already high national average

The census indicated that Toronto ranked No. 1 among the country's 35 census metropolitan areas

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3 | VERTICAL GROWTH / INTENSIFICATION IN ONTARIO

Greenbelt Area, Ontario

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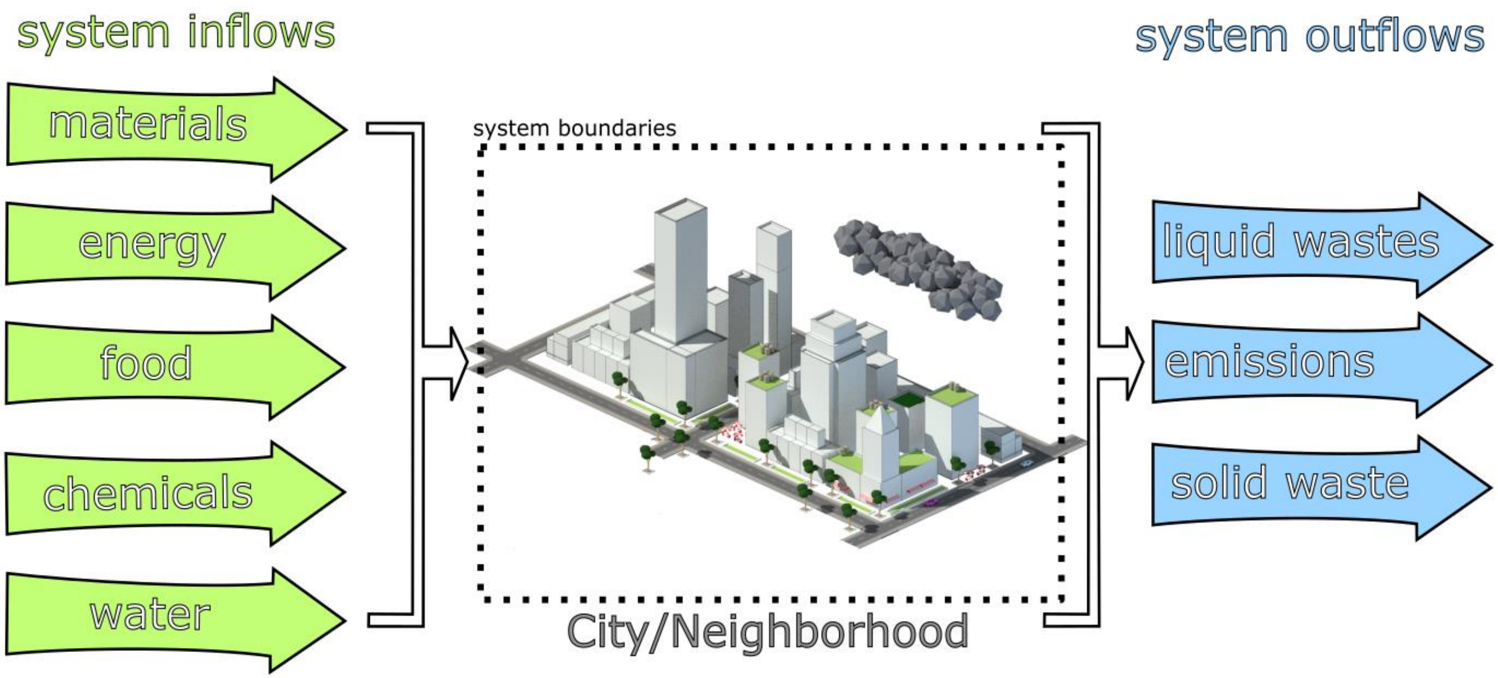
4 | PARTICIPATORY AND BOTTOM-UP MODELING

Integrated Water Resources Evaluation Tool [IWRET]

Collaboration between Ryerson University and Waterfront Toronto

5 | METHODOLOGICAL BASIS



Concept of Urban Metabolism, after Abel Wolman

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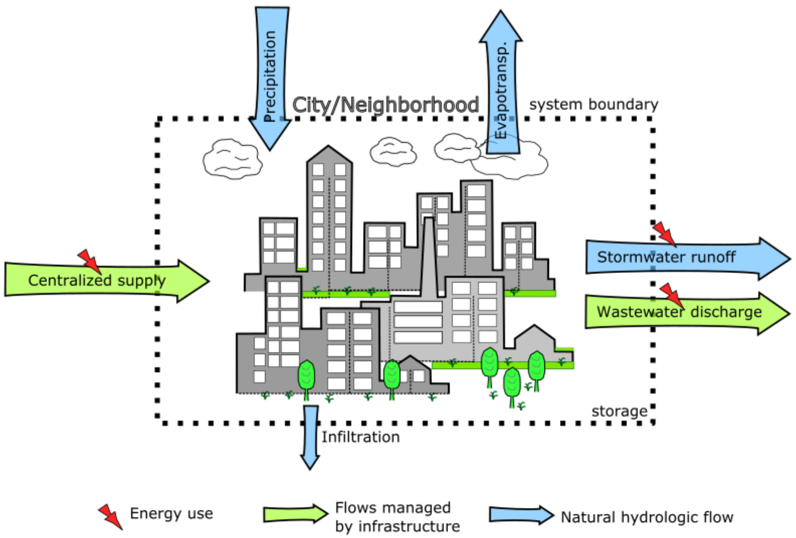
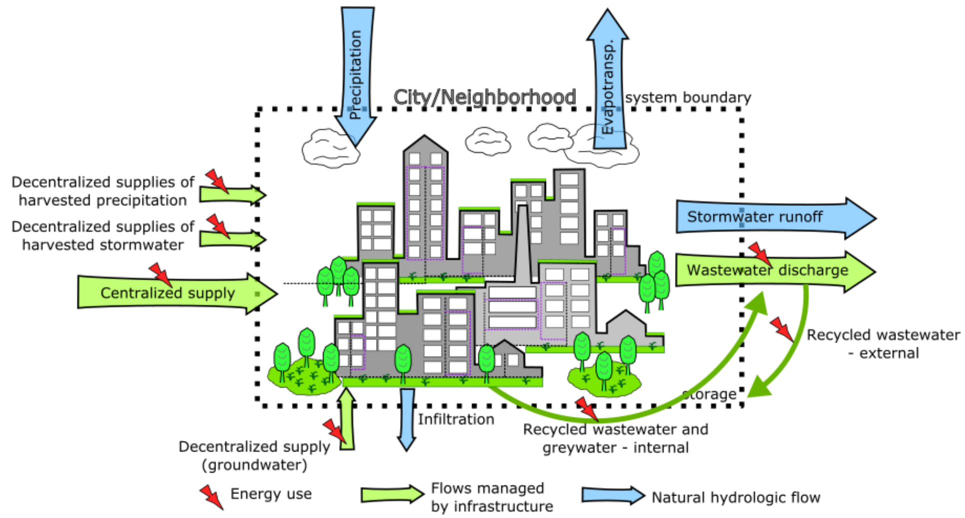
6 | ALTERNATIVE APPROACHES TO METABOLISM OF UWS



Centralized [Traditional] approach



Decentralized [Hybrid] approach

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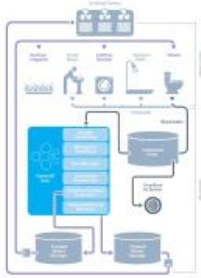
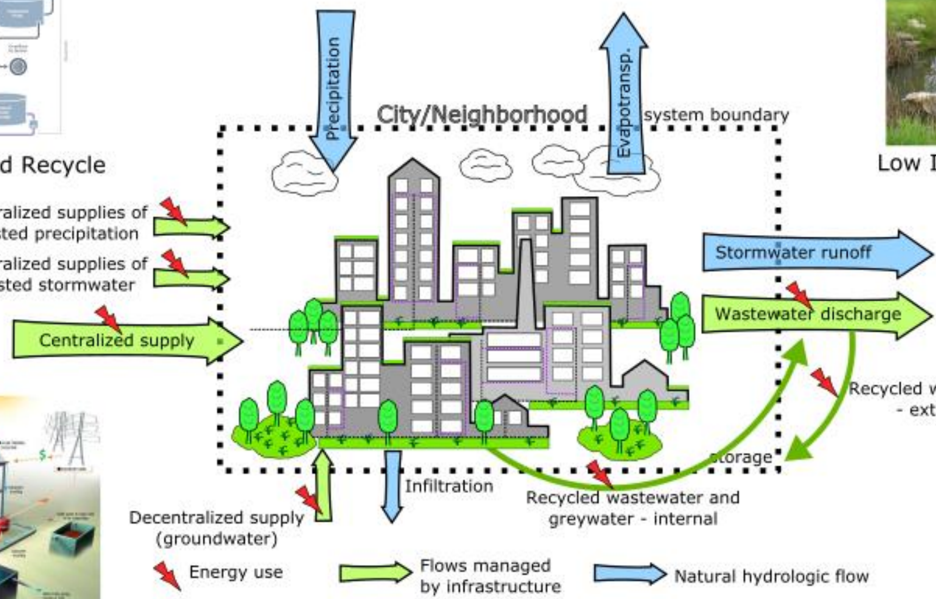
7 | CHANGING URBAN MORPHOLOGY

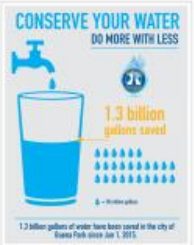


Water Reuse and Recycle

Low Impact Development (LID) / Green Infrastructure



Green Buildings



Water demand and supply management

Technologies used to balance urban water metabolic process

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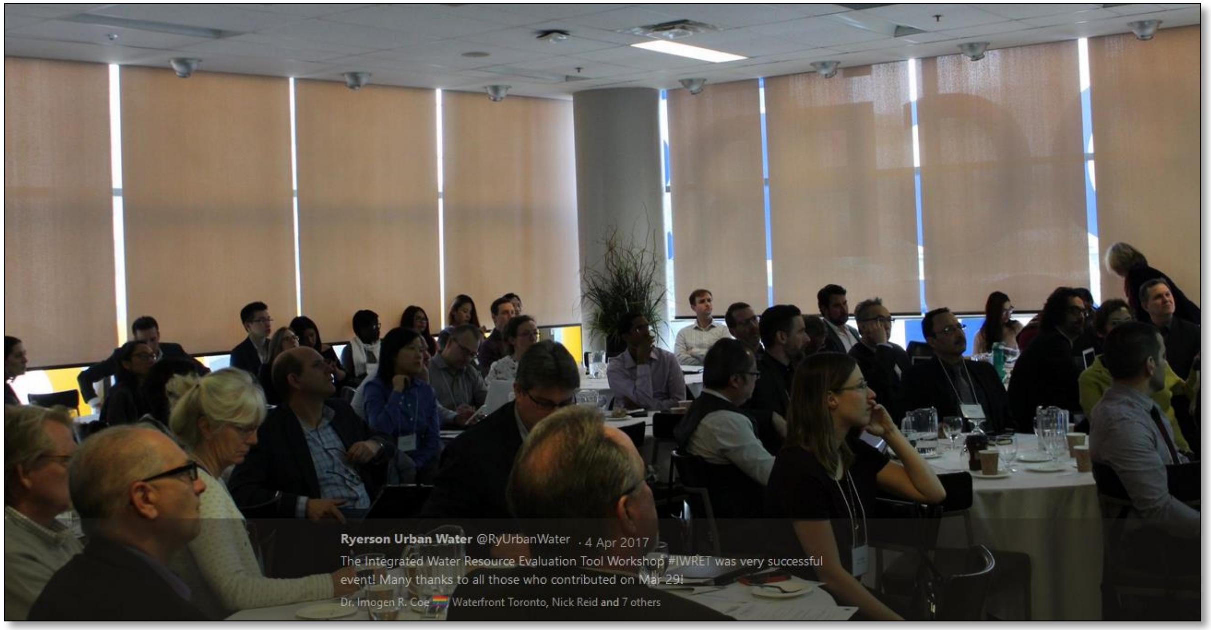
8 | PARTICIPATION OF STAKEHOLDERS



IWRET Workshop survey topics:

i. Decentralized technologies;
ii. Quantitative and qualitative indicators of sustainability;
iii. Graphic user interface (GUI).

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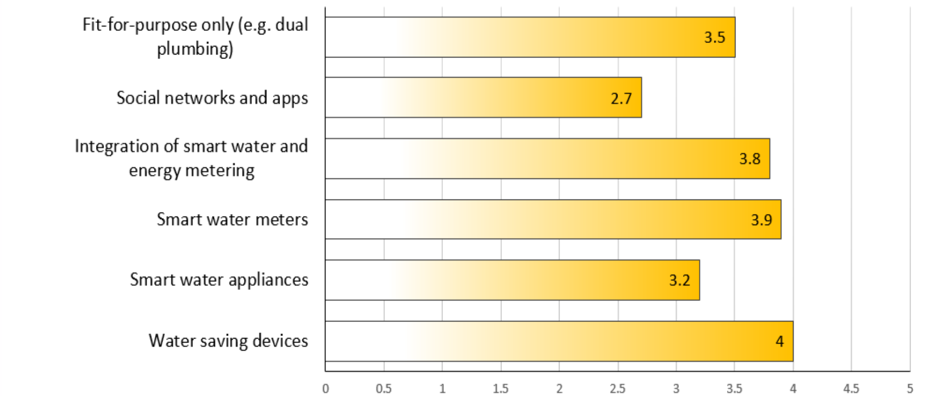
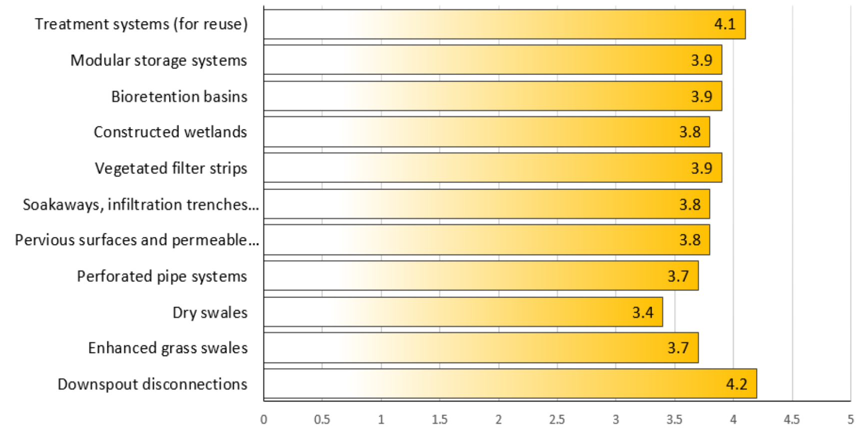
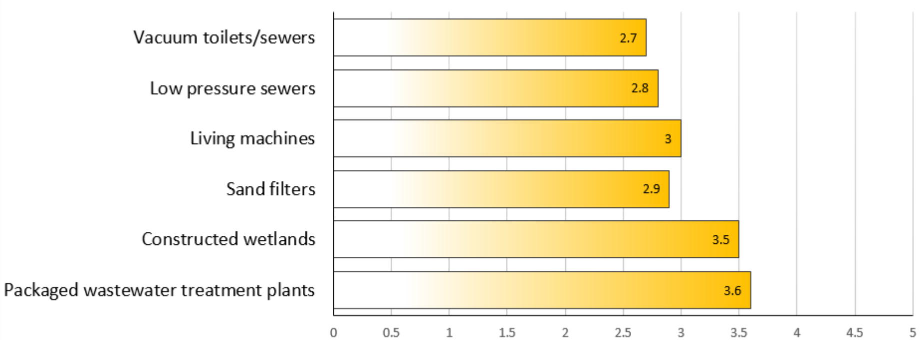
9 | PREFERED TECHNOLOGIES



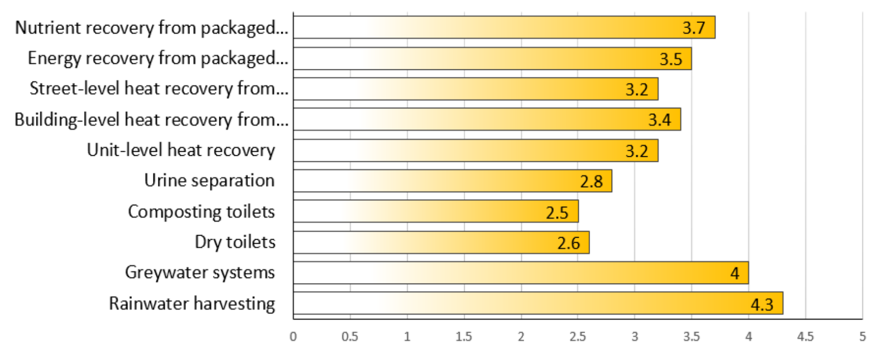
Water Supply



Stormwater



Wastewater



Reuse/Recycle

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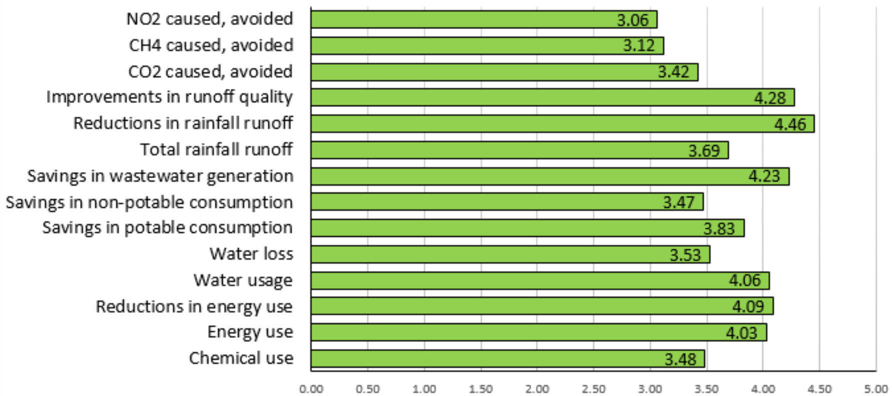
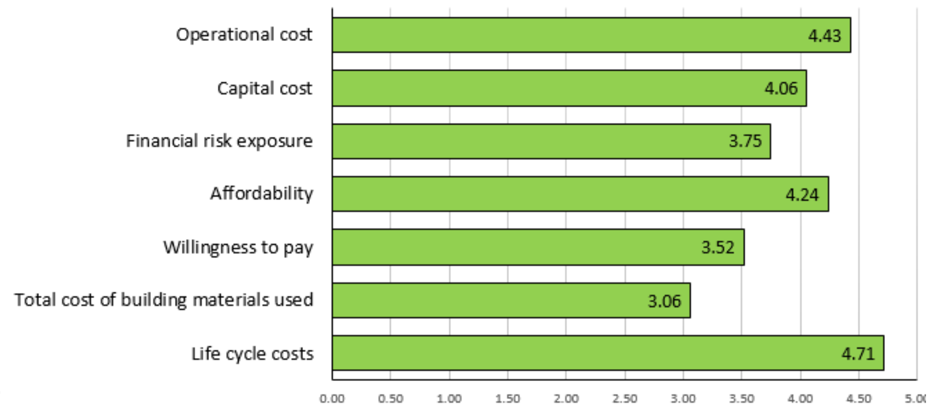
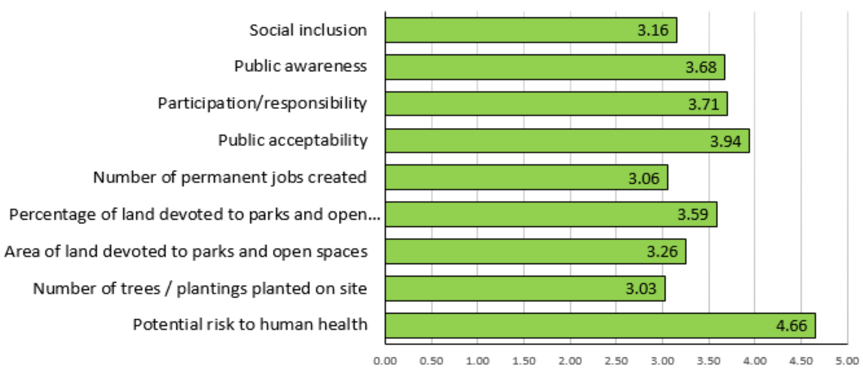
10 | PREFERED INDICATORS OF SUSTAINABILITY



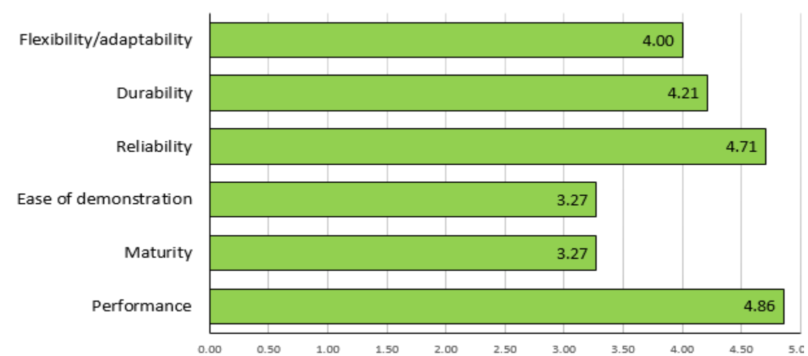
Environmental



Economic



Socio-cultural



Engineering

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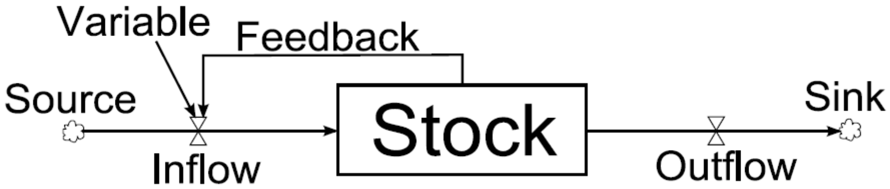
11 | CHOOSING MODELING METHOD



Main Elements of System Dynamics (SD) Simulation Model

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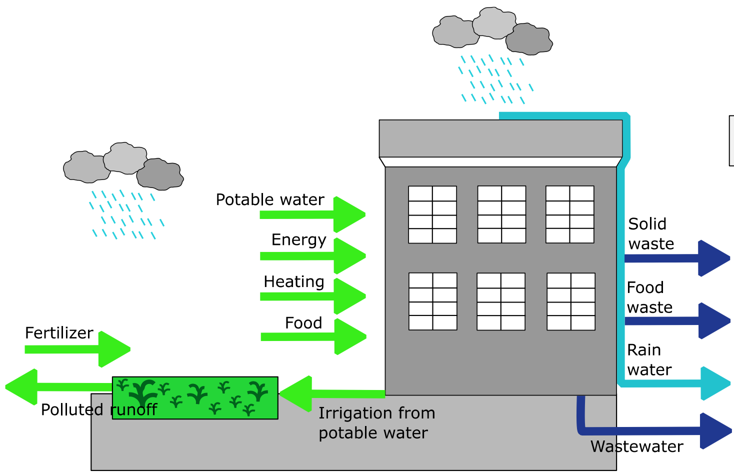
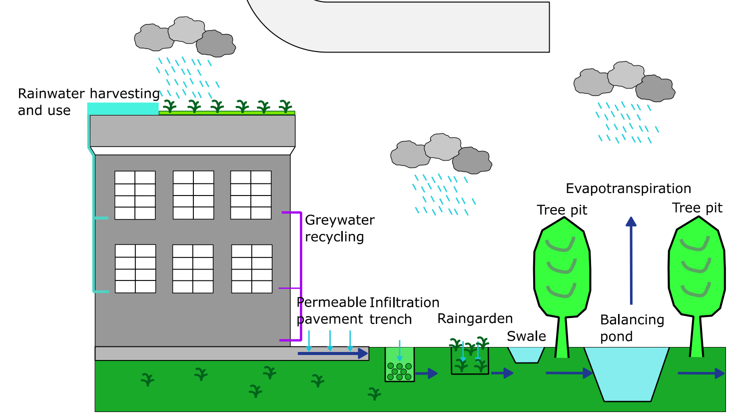
12 | ARCHITECTURE OF HYBRID WATER SYSTEMS



Centralized System

Urban Hybrid System

- Integrating all elements of urban water cycle;
- Including all four groups of decentralized solutions to allow flexible representation of hybrid water systems;
- Integrating of sustainability performance indicators recognized by the potential users;
- Use open-source technology, publicly available for use, modification and distribution; and,
- Incorporating low data requirements typically used for master planning;



Decentralized System

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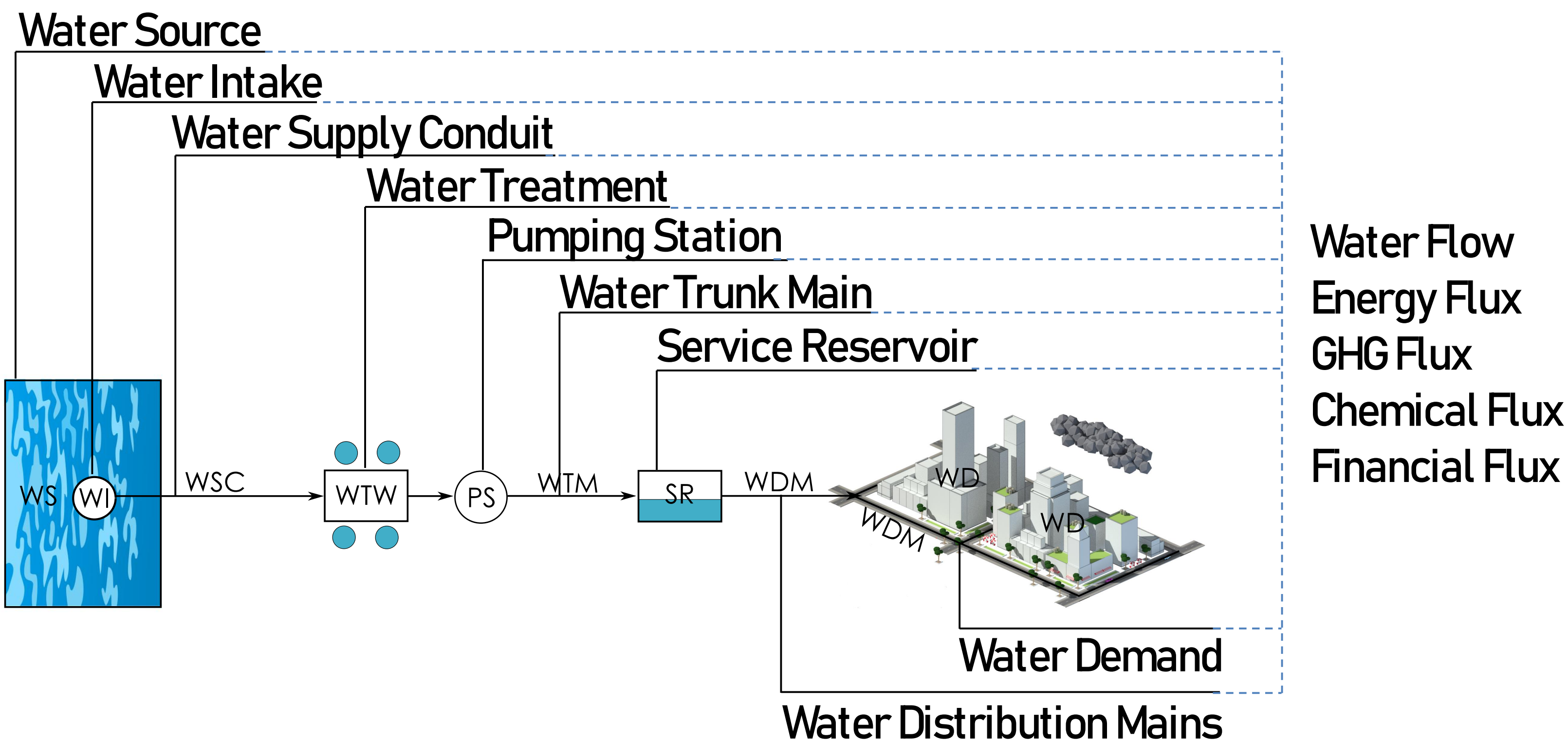
13 | SPATIAL AND TEMPORAL SCALES

- Level 1: Indoor Area
- Level 2: Neighborhood Area
- Level 3: Urban Water Utility Area

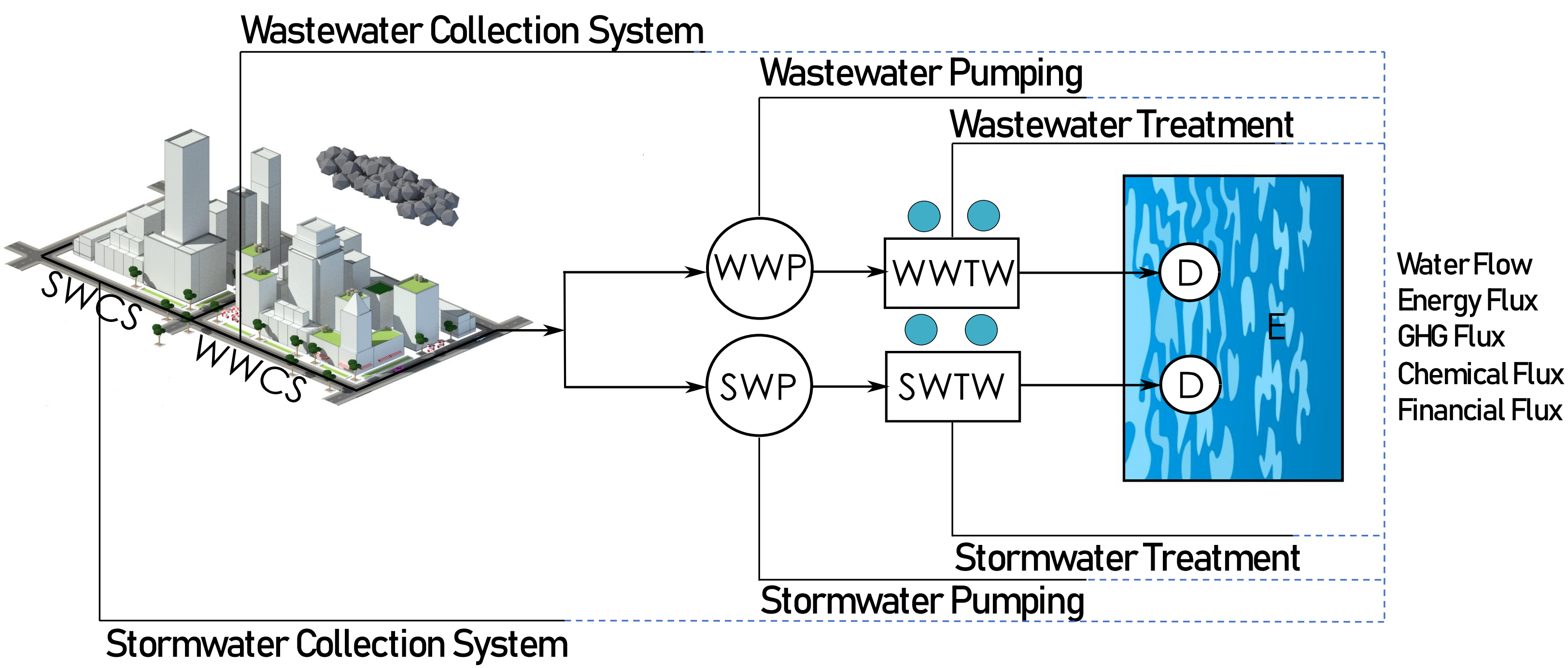
Three spatial scales represented in IWRET

14 | ELEMENTS OF WATER SUPPLY COMPONENT



Visualization of the water supply component

15 | ELEMENTS OF SEWARAGE COMPONENT



Visualization of the waste and stormwater component

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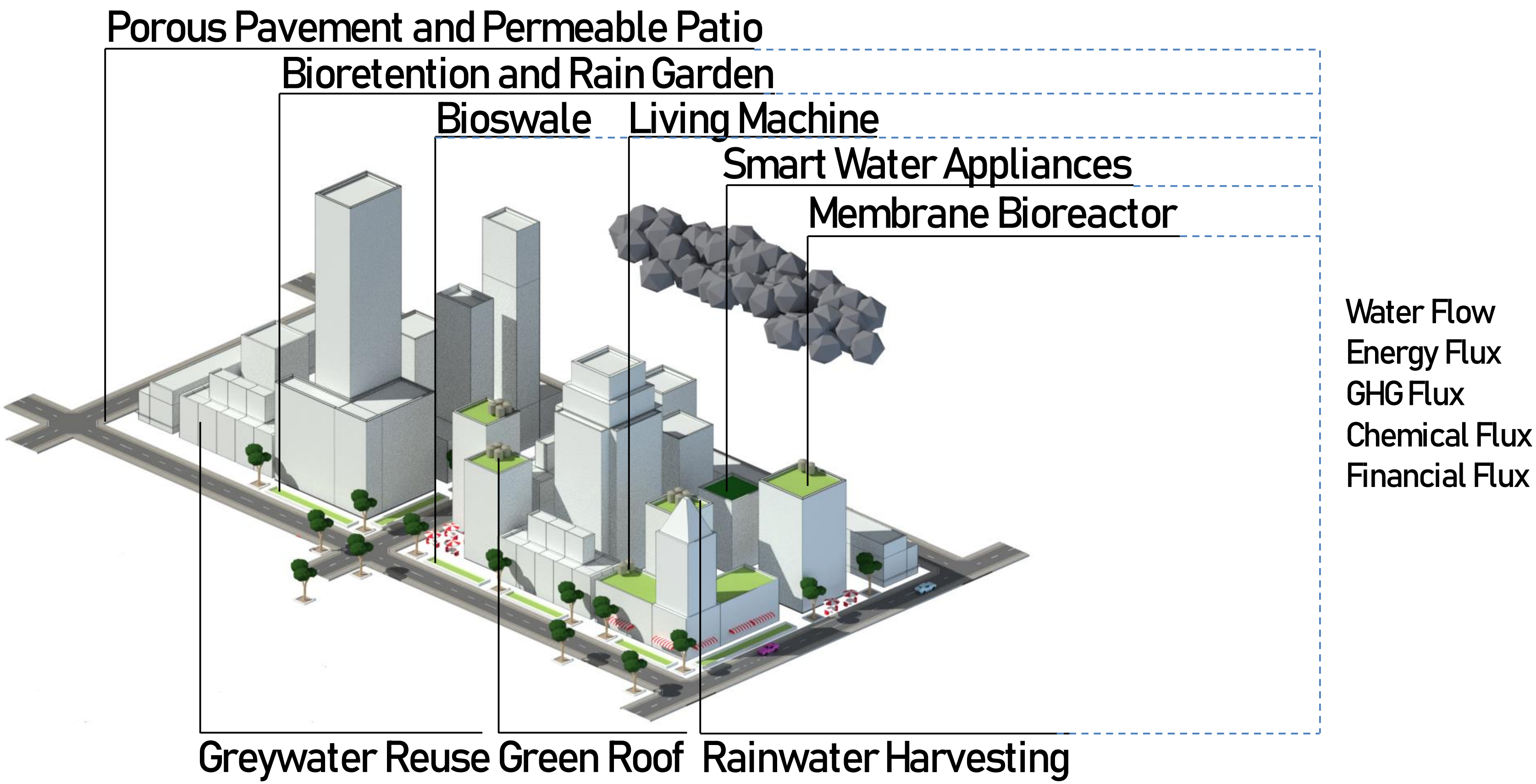
16 | CHANGING MORPHOLOGY OF WATER SYSTEMS



Visualization of decentralized options

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17 | LIST OF MAJOR MODEL OUTPUTS

Description	Presentation
Neighborhood	
Single family units over time	Continuous graph - line
Multi-family units over time	Continuous graph - line
Water and Wastewater Balance	
Water demand for irrigation	Continuous graph - line
Water demand for domestic use	Continuous graph - line
Water demand for commercial and institutional activities	Continuous graph - line
Water demand for industrial activities	Continuous graph - line
Total daily demand of potable water	Continuous graph - line
Total water loss due to leakage in water supply system	Number
Treated Wastewater in WWTW	Continuous graph - line
Stormwater	
Daily precipitation	Histogram, bars
Daily stormwater runoff	Continuous graph - line
Runoff from impervious areas	Continuous graph - line
Reuse and Recycle	
Rainwater harvested daily	Continuous graph - line
Total volume of harvested rainwater	Number
Greywater collected daily	Continuous graph - line
Blackwater collected daily	Continuous graph - line
Total volume of treated blackwater	Number
Financial	
Capital investments required for system extension	Number
Installation and construction costs of new system elements	Number
Costs of operation	Number
Costs required for system maintenance	Number
Sum of all system costs	Number
Energy and Greenhouse Gas Emissions	
Energy required for system operation	Number
Embodied energy required for system for system construction	Number
Embodied GHG required for system for system construction	Number
GHG emissions during system operation	Number

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19 | TYPES OF QUESTIONS

- Quantify the metabolic performance of UWS across the urban water cycle.
- What would be the impact of different configurations of the UWS on the long-term sustainability performance?
- What particular environmental categories would have positive, and what categories would have negative impacts?
- What would be consumed, recovered, caused and avoided environmental impacts of different technologies?
- Would there be reductions in rainfall runoff?
- Would there be savings in potable water consumption?

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THANK YOU FOR YOUR EFFORT AND ASSISTANCE