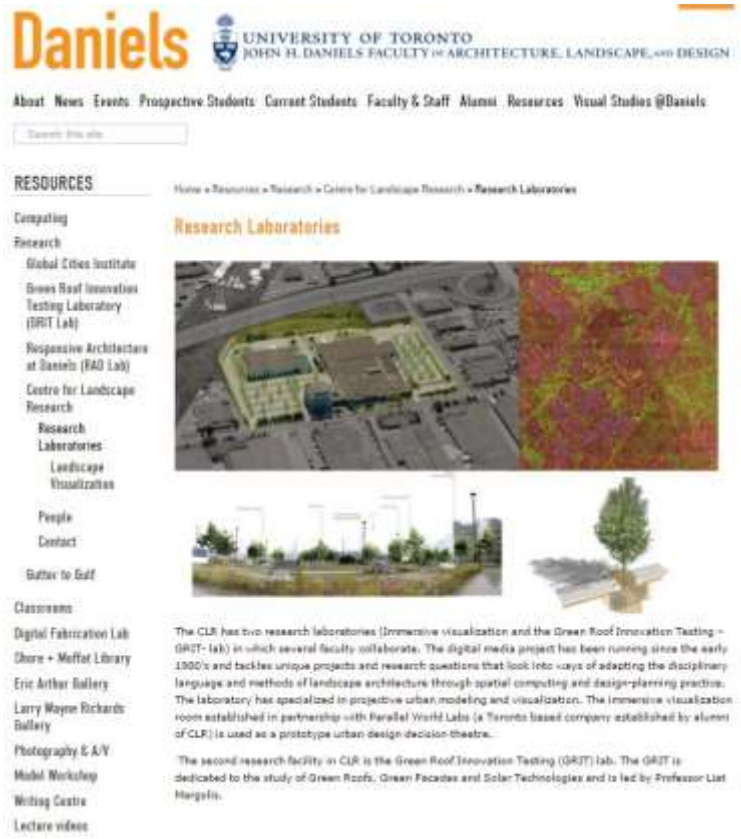
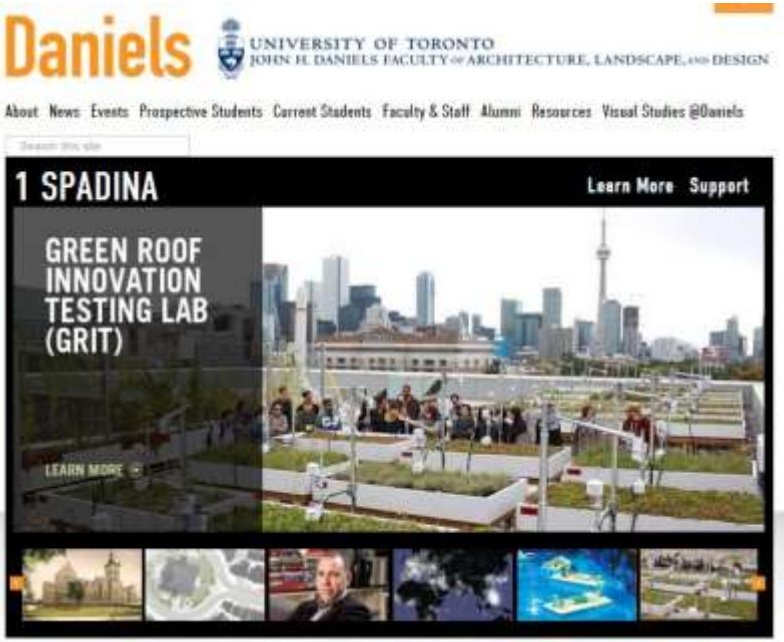
Visioning & Testing Urban Futures: Exploring a Smart Cities Approach to the Greater Toronto Area

John Danahy
Centre for Landscape Research, Cities Centre,
& Knowledge Media Design Institute
University of Toronto





Smart Cities Research at the Daniels Faculty, University of Toronto

The University of Toronto's Knowledge Media Design Institute was established within the School of Graduate Studies in the spring of 1996, and now consists of over 85 faculty members from 25 different academic departments. Drawing on the expertise of our membership, the Knowledge Media Design Institute has roots in a number of intellectual traditions in which University of Toronto faculty have played an important role.

McLuhan Program
Department of Computer Science
Biomedical Communications
Dynamic Graphics Project
Department of Sociology
Human Factors Group
Centre for Landscape Research
Ontario Telepresence Project

KMDI – Knowledge Media Design Institute, Faculty of Information, University of Toronto

Professor **Eric Miller** (CivE) was awarded more than $2.9 million to create and implement iCity, a virtual lab for urban design that will develop and apply advanced data, analysis and visualization capabilities to find groundbreaking ways to improve urban transportation system performance. The system will help design efficient, sustainable cities for the well-being of individuals and society.

Professor Christopher Kennedy

Environmental Engineering Research Group

Contact me

Christopher Kennedy
Dept. of Civil Engineering
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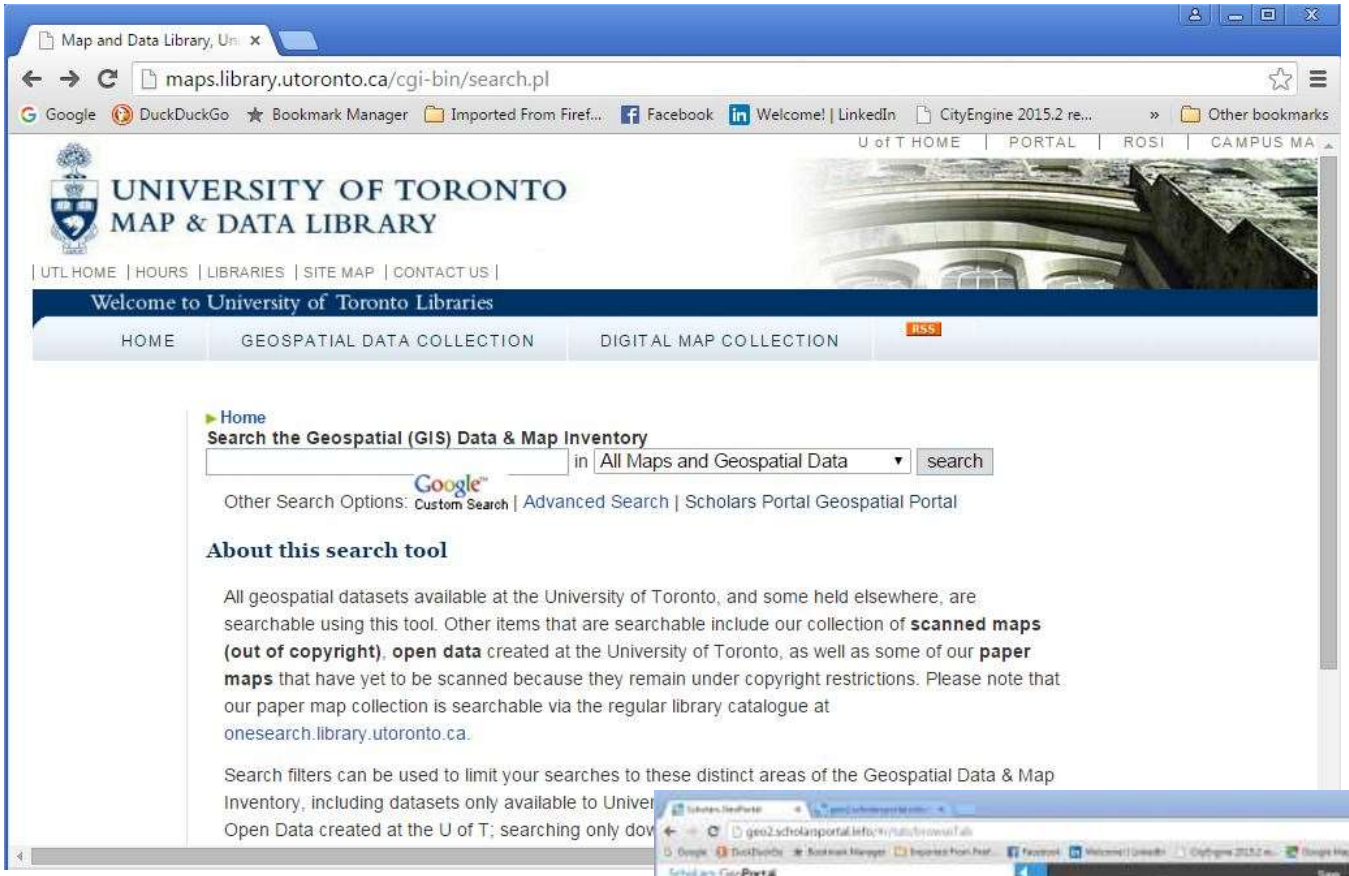
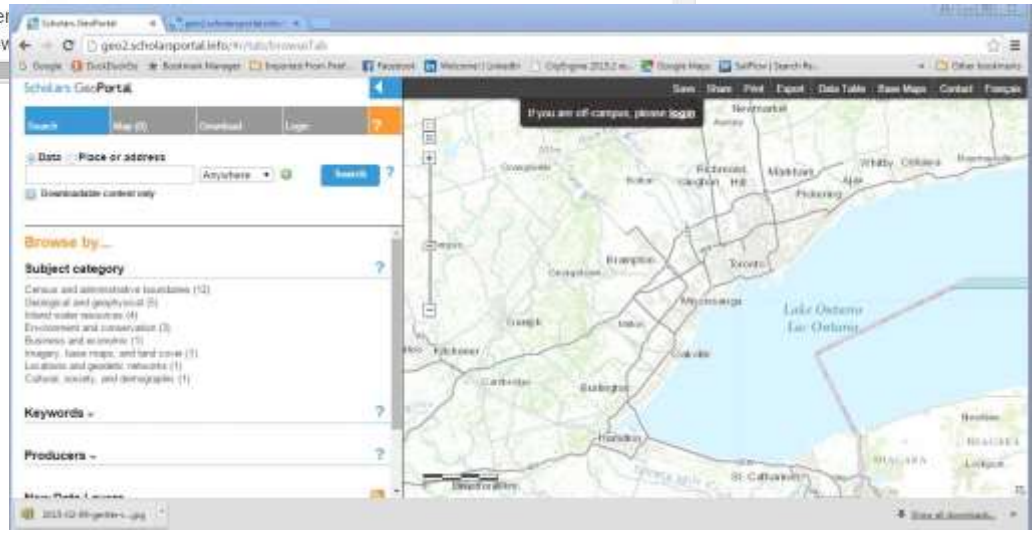
Research Interests

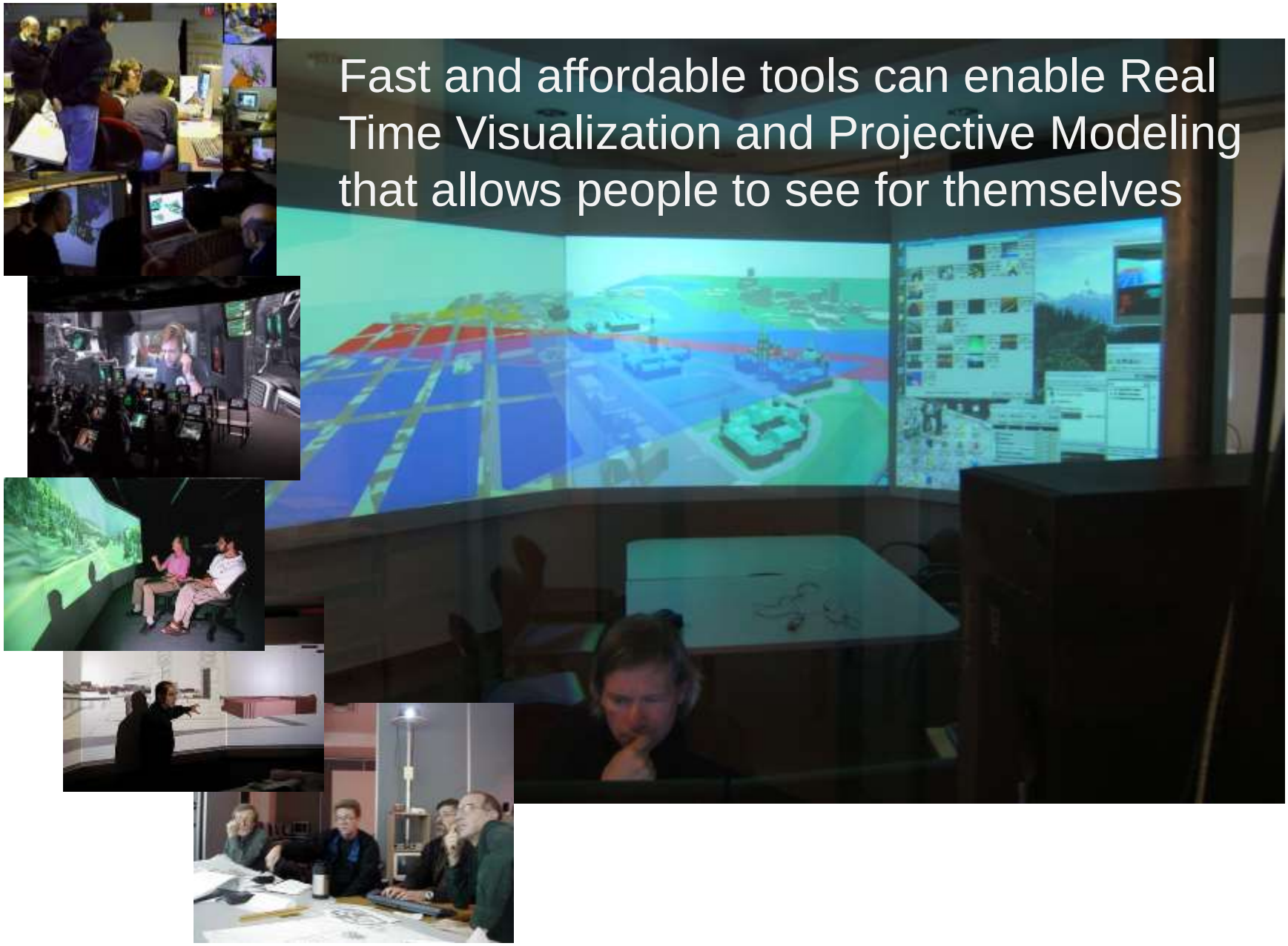
Economic and environmental aspects of sustainable urban infrastructure including transportation, buildings and water systems; Design of sustainable streets and neighbourhoods; Urban metabolism.

Smart Cities Research at the Faculty of Engineering, University of Toronto

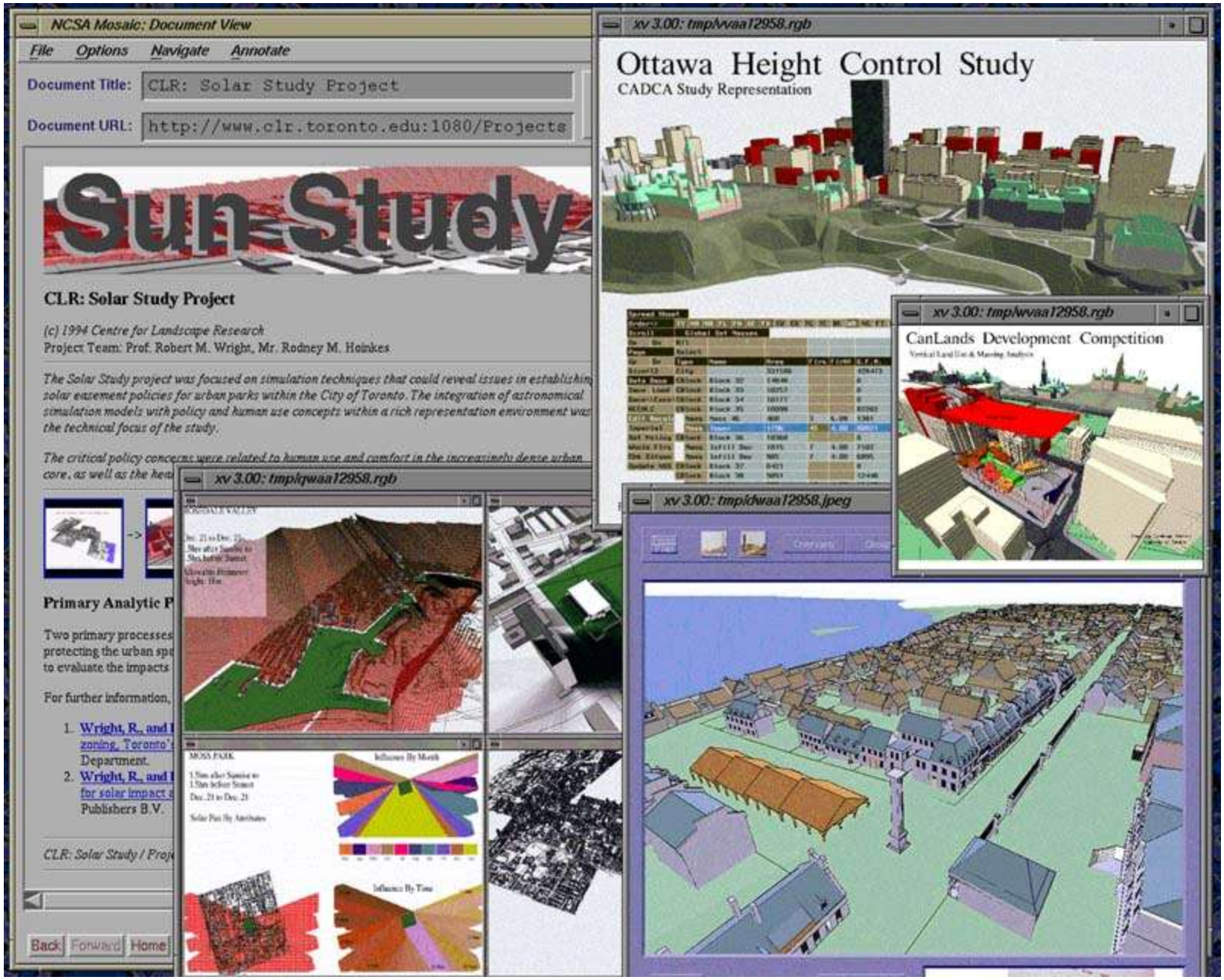




Geospatial Collections at the UofT Digital Map Library and the Ontario Scholars GeoPortal that support Smart Cities Research

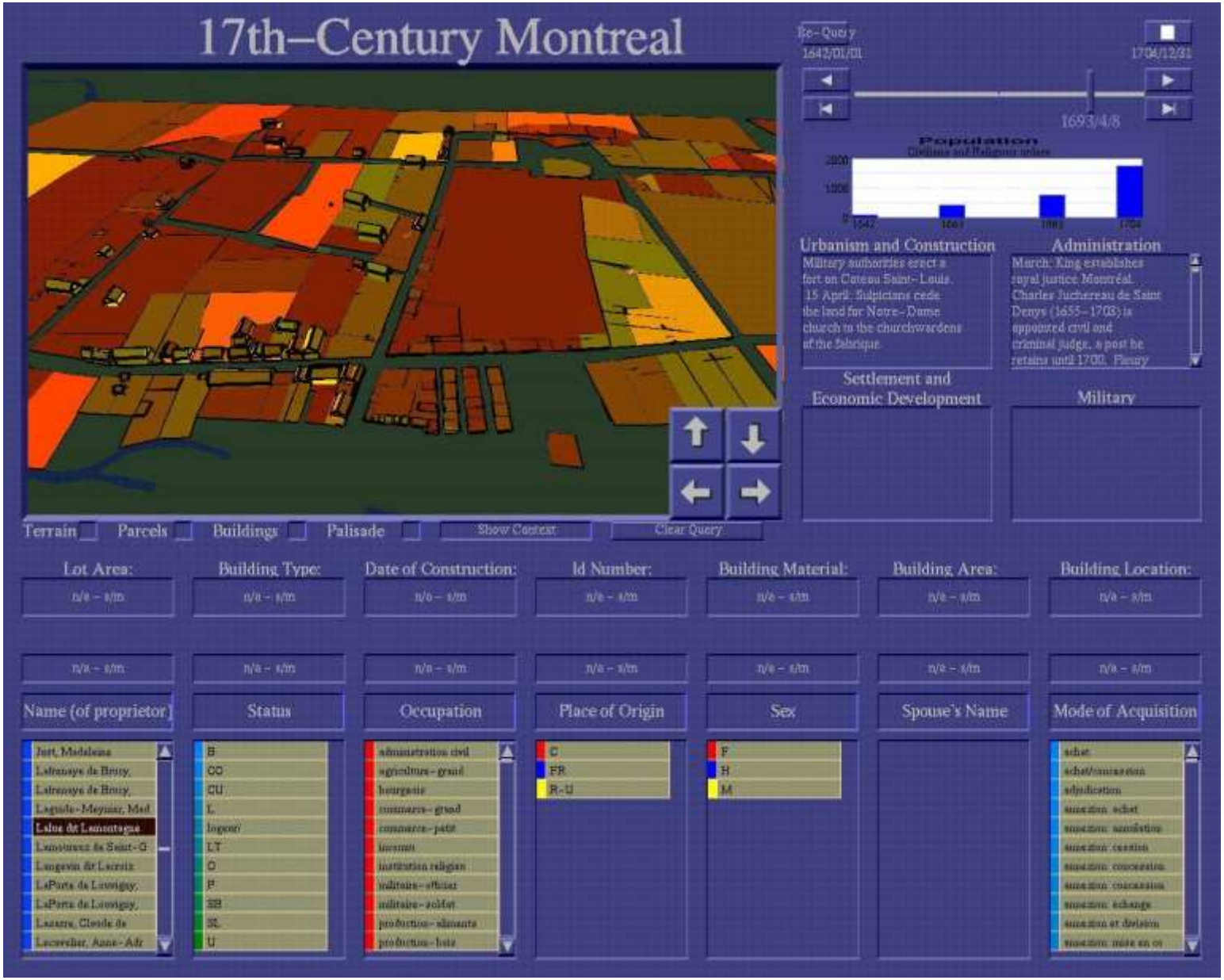


Steinitz, Ervin, Hoinkes, Wright, Bohus, Danahy, Bishop, Allsopp, Greenberg, Stirling



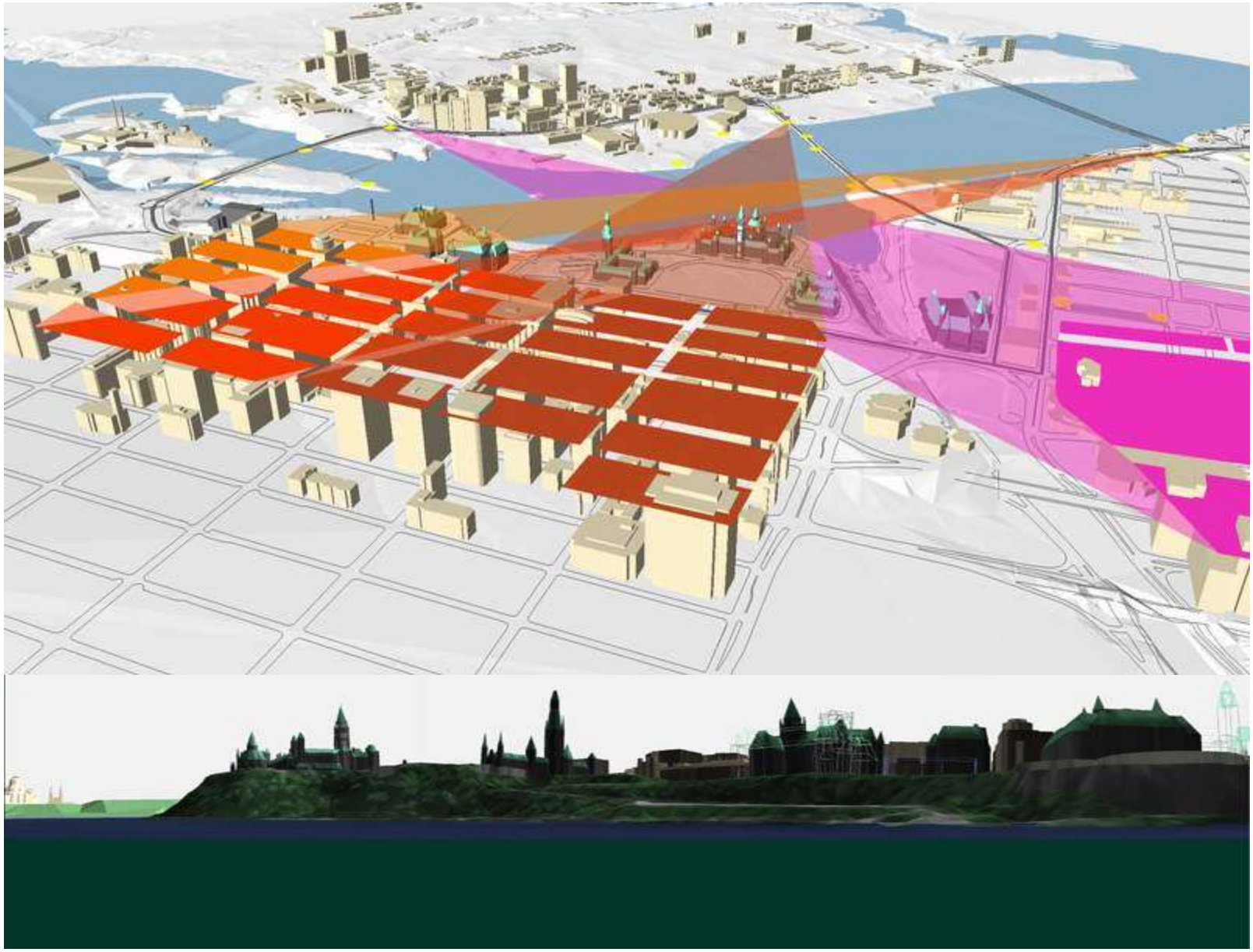
Centre for Landscape Research – Real-time 4D data driven and analytical interactive City models

Centre for Landscape Research – Canadian Centre for Architecture – 4D data driven timeline 3D interactive City model of Montreal 1700s – 1800s



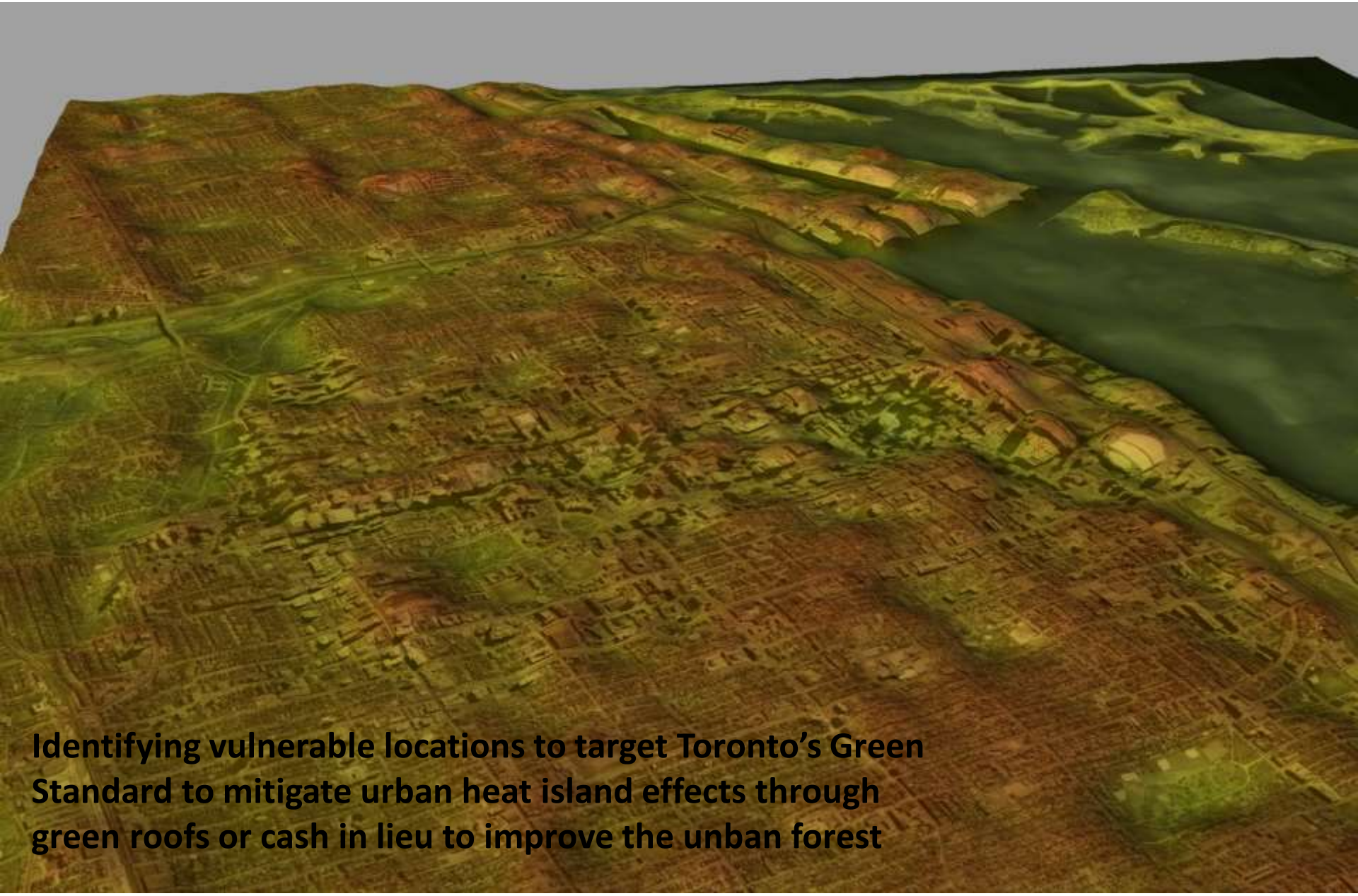
Centre for Landscape Research – Canadian Centre for Architecture – 4D data driven timeline 3D interactive City model of Montreal 1700s – 1800s

Ottawa National Capital Views Real-time Evaluation and Change Model



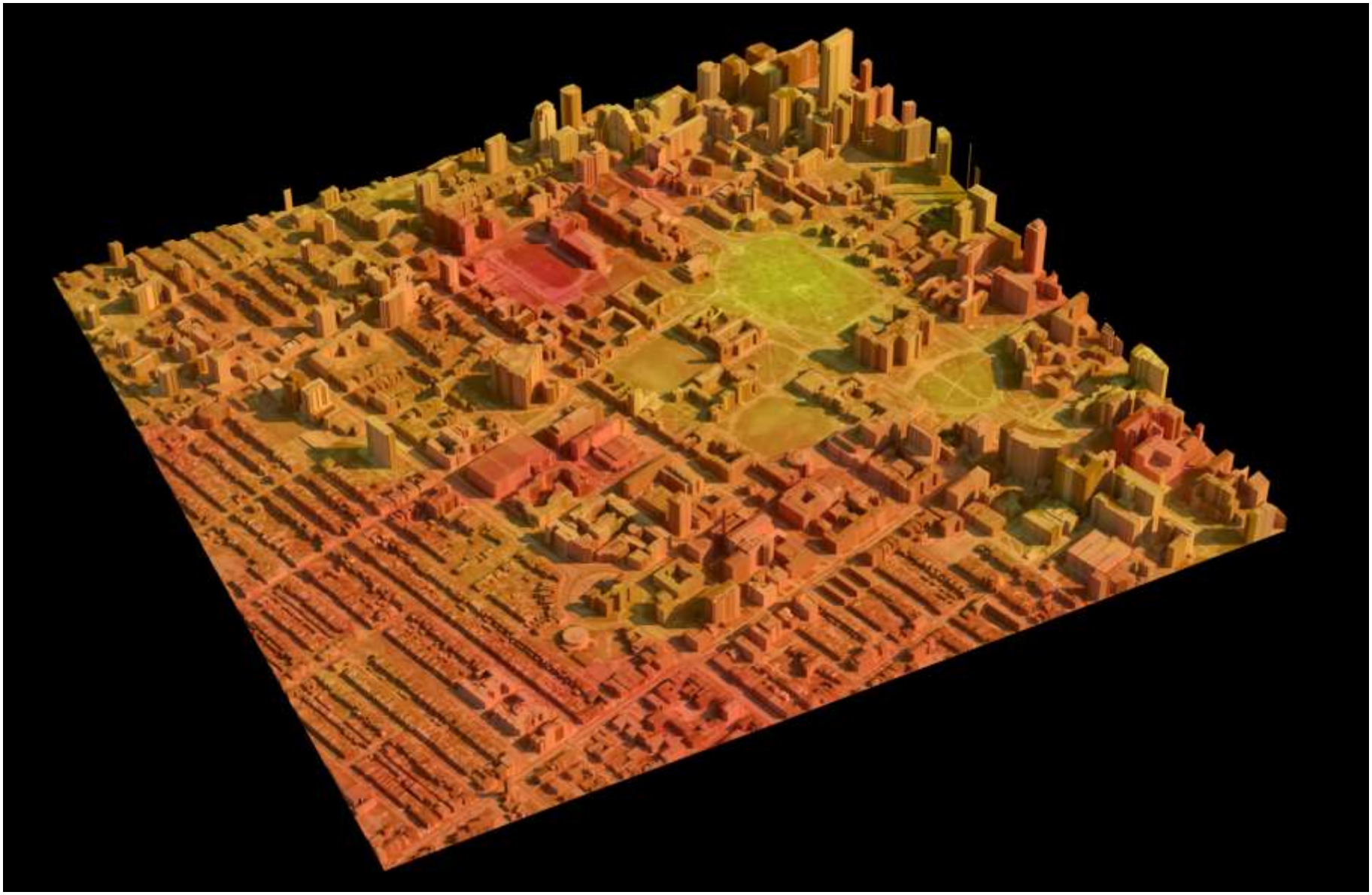
Ottawa National Symbols Views Control and Economic Capacity Negotiations CLR-UofT, DTAH, NCC, 1990-2000

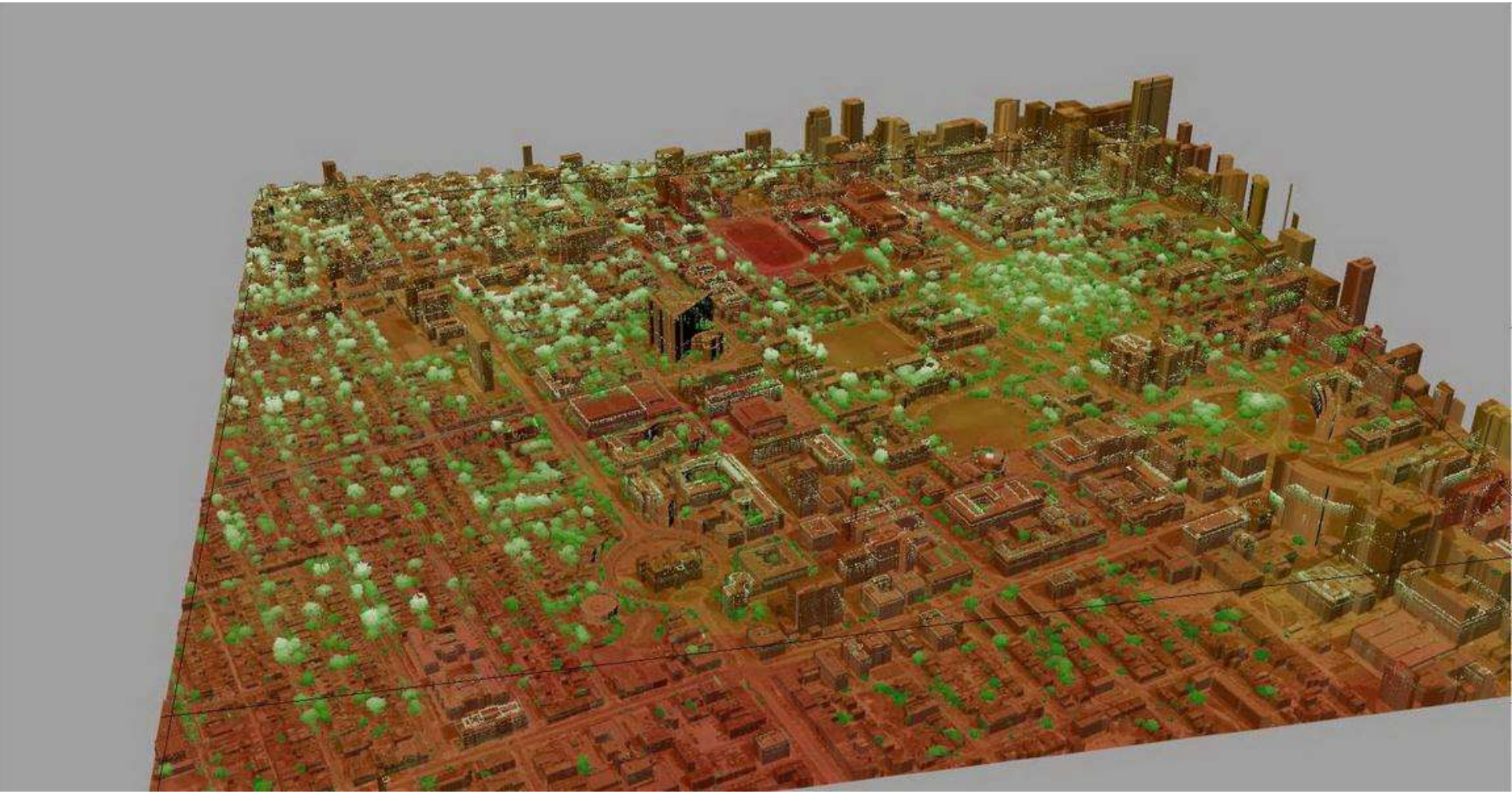
Combining Remote sensed temperature with 3D built form to study urban heat island issues - CLR GEOIDE NCE



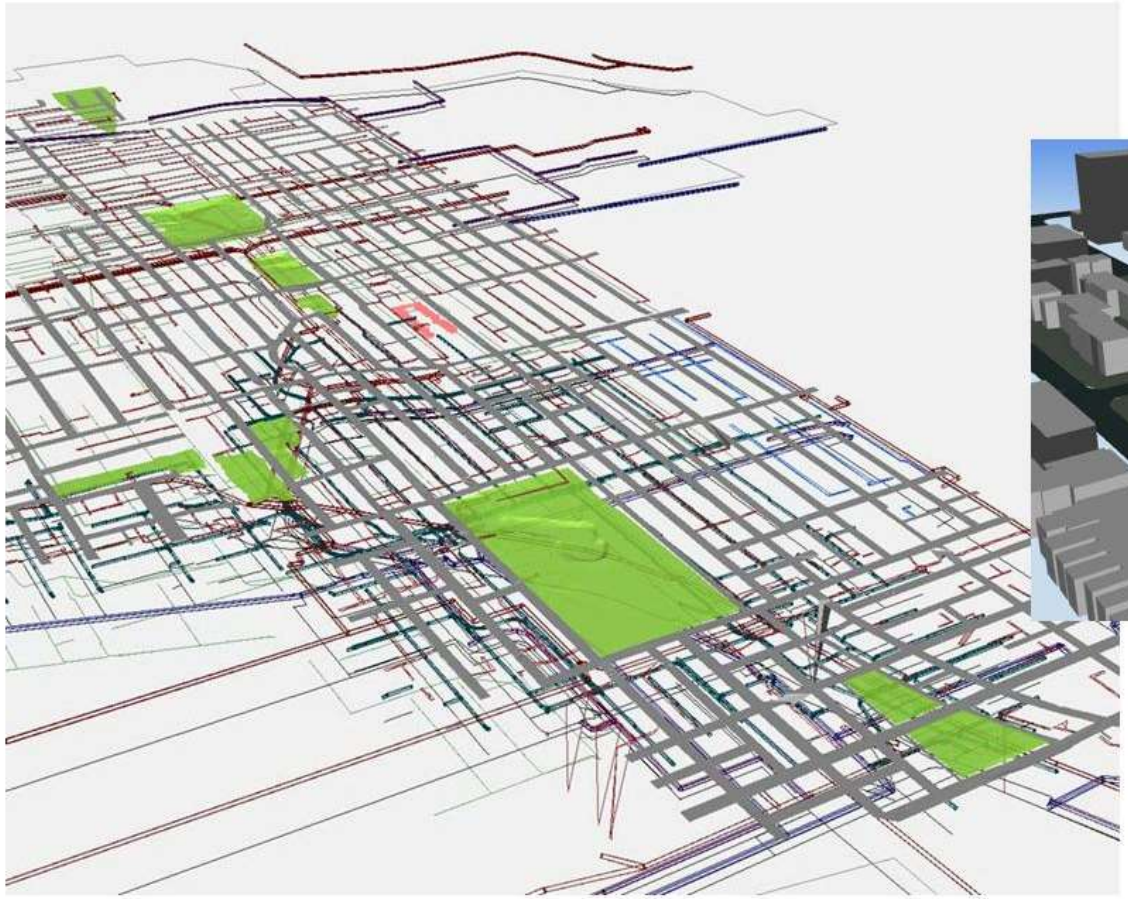
Combining Remote sensed temperature with 3D built form to study urban heat island issues

CLR GEOIDE NCE





Centre for Landscape Research – GEOIDE NCE – Combined model of 3D City, with heat island data and lidar tree canopy



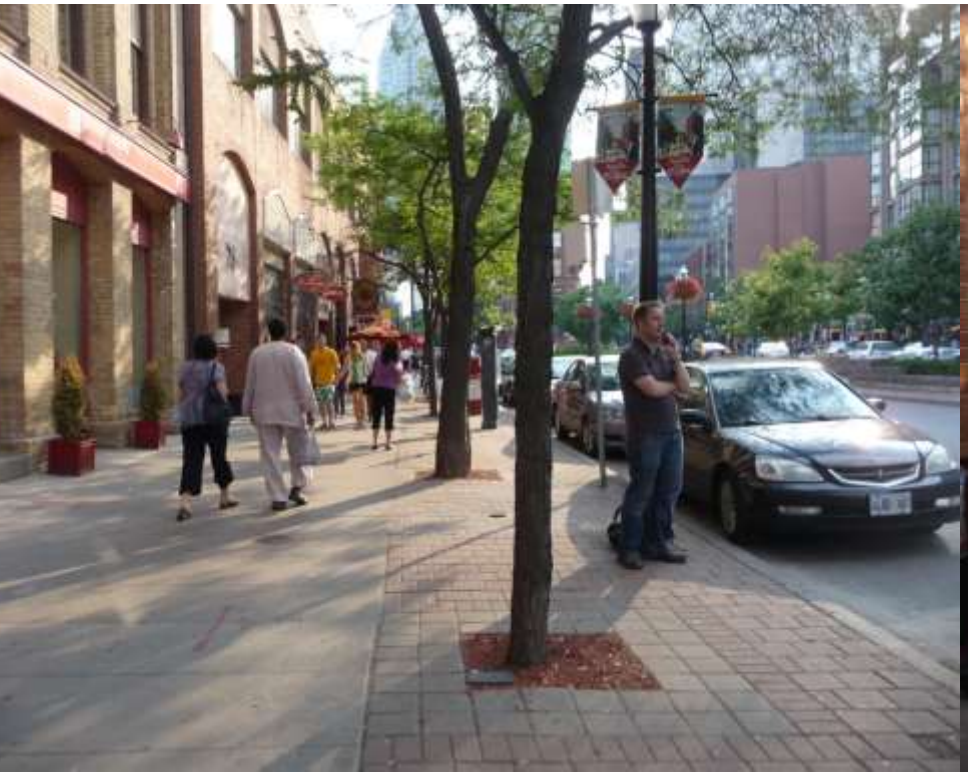
Centre for Landscape Research – City of Toronto – 3D model of Garrison Creek underground infrastructure with 3D VR model.

The overall problem with this phenomenon in Canadian cities is that the livable pre automobile streetcar landscape of the large 19th Century cities is at capacity.

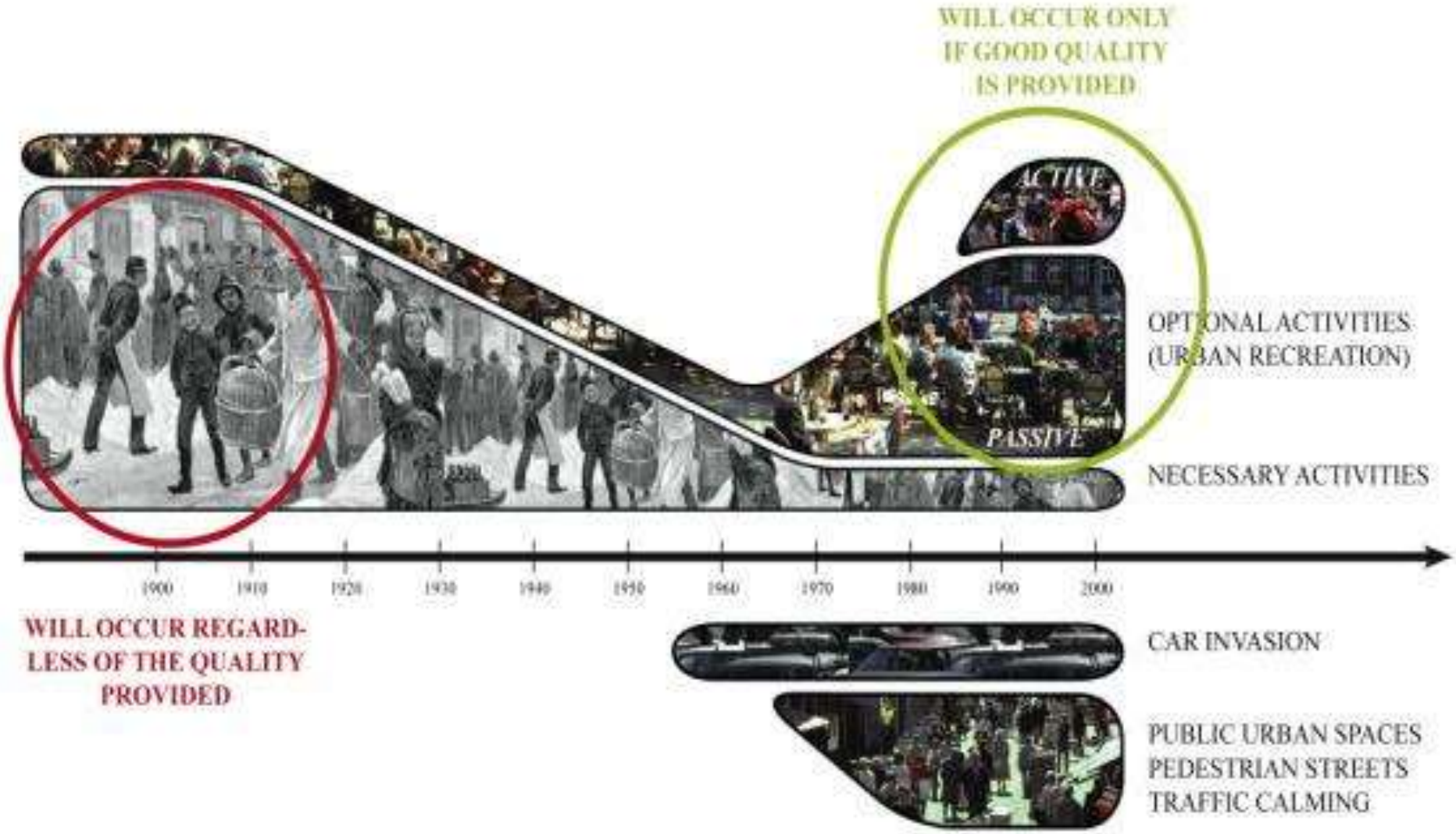
Urbanity is a new phenomenon in most Canadian cities.

For instance, only thirty years ago it was against the law to have an outdoor café in Toronto, there were no sidewalk amenities or trees on Metropolitan roads

Today, many people have discovered positive aspects of urban living

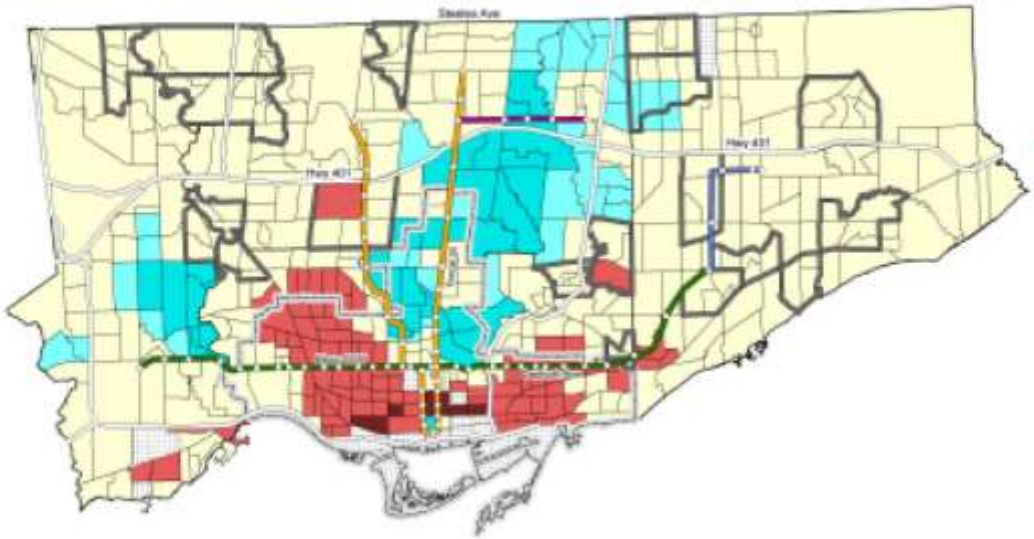


and a reverse migration is fostering lifestyles that minimize the need for a car.



Jan Gehl's analysis of the shift in the role of the public realm street from a place of necessary work activity to a place for freedom of choice activities and urban social life.

MAP 2: AVERAGE INDIVIDUAL INCOME, CITY OF TORONTO, Relative to the Toronto CMA, 1970



Census Tract Average Individual Income Relative to the Toronto CMA Average of $30,800* (estimated to 2001 census boundaries)

Very High	High	Middle Income	Low	Very Low
More than 40% Above	20% to 40% Above	20% Below to 20% Above	20% to 40% Below	More than 40% Below
36 Tracts, 7% of City	*41 Tracts, 8% of City*	*341 Tracts, 66% of City*	*91 Tracts, 18% of City*	*6 Tracts, 1% of City*
*Average = $54,700**	*Average = $39,000**	*Average = $29,800**	*Average = $22,300**	*Average = $17,000**

* *Average incomes in constant 2005 dollars*

WHAT IS A NEIGHBOURHOOD?

There is no one way to draw boundaries that define specific neighbourhoods. Defining a neighbourhood is, in the end, a subjective process. Neighbourhoods encompass each resident's sense of community life. There is no doubt, however, about the importance of neighbourhoods and their effects on health, educational outcomes, and overall well-being.

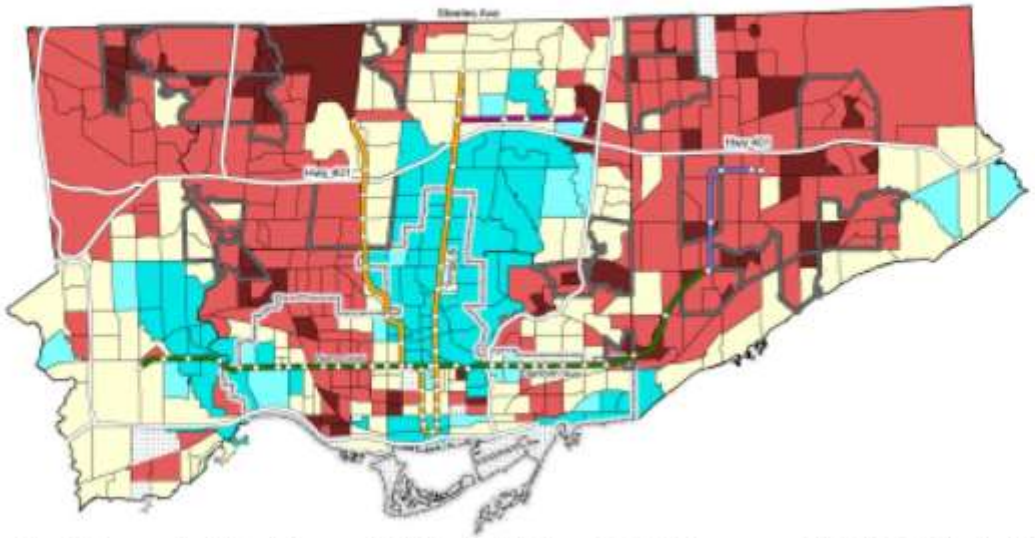
For statistical reporting and research purposes, Statistics Canada defines "neighbourhood-like" local areas called census tracts. In defining census tracts, Statistics Canada uses recognizable physical boundaries (such as roads, railway lines, or rivers) to define compact shapes, within which can be found a more or less homogeneous population in terms of socio-economic characteristics. The population of a census tract is generally 2,500 to 8,000. The City of Toronto encompasses 531 census tracts (as of the 2006 Census). Each has an average population of about 4,700 people. "Census tract" is used here interchangeably with the term "neighbourhood."

In this study, our definition of a "neighbourhood" differs from that of the City of Toronto, which has defined and named only 140 neighbourhoods. Each represents a group of census tracts — on average, 3.8 census tracts and about 17,900 people. The city's definition of neighbourhoods helps define and provide names for districts within the city, but they are too large to represent the lived experience of a neighbourhood. Individual census tracts come closer to that experience, even though they are statistical artifacts and do not always capture the true notion of neighbourhood.

David Hulchanski, Cities Centre, UofT

However, gentrification and cost have supplanted the original high quality immigrant staging neighbourhoods that are inherently walkable and have the highest possibilities for urbanity.

MAP 3: AVERAGE INDIVIDUAL INCOME, CITY OF TORONTO, Relative to the Toronto CMA, 2005



2005

Census Tract Average Individual Income Relative to the Toronto CMA Average of $40,704 (estimated to 2001 census boundaries)

Very High	High	Middle Income	Low	Very Low
More than 40% Above	20% to 40% Above	20% Below to 20% Above	20% to 40% Below	More than 40% Below
76 Tracts, 15% of City	*21 Tracts, 4% of City*	*152 tracts, 29% of City*	*206 Tracts, 40% of City*	*67 Census Tracts, 14% of City*
Average = $104,000	*Average = $53,500*	*Average = $39,000*	*Average = $28,000*	*Average = $22,500*

NEIGHBOURHOOD POLARIZATION SINCE 1970: THREE DISTINCT CITIES EMERGE WITHIN TORONTO

The City of Toronto is huge: 632 square kilometres (244 square miles). With more than 2.5 million people living in its residential areas, a 20% increase since the early 1970s, the nature of its neighbourhoods has changed over time to reflect significant changes in the demographic characteristics and economic situation of their residents. Thirty-five years is an adequate period to examine the nature of change in neighbourhood characteristics and to identify trends.

Many of the questions asked in the 1971 census are still used in current census forms; therefore it is possible to analyse many aspects of neighbourhood change since that time.

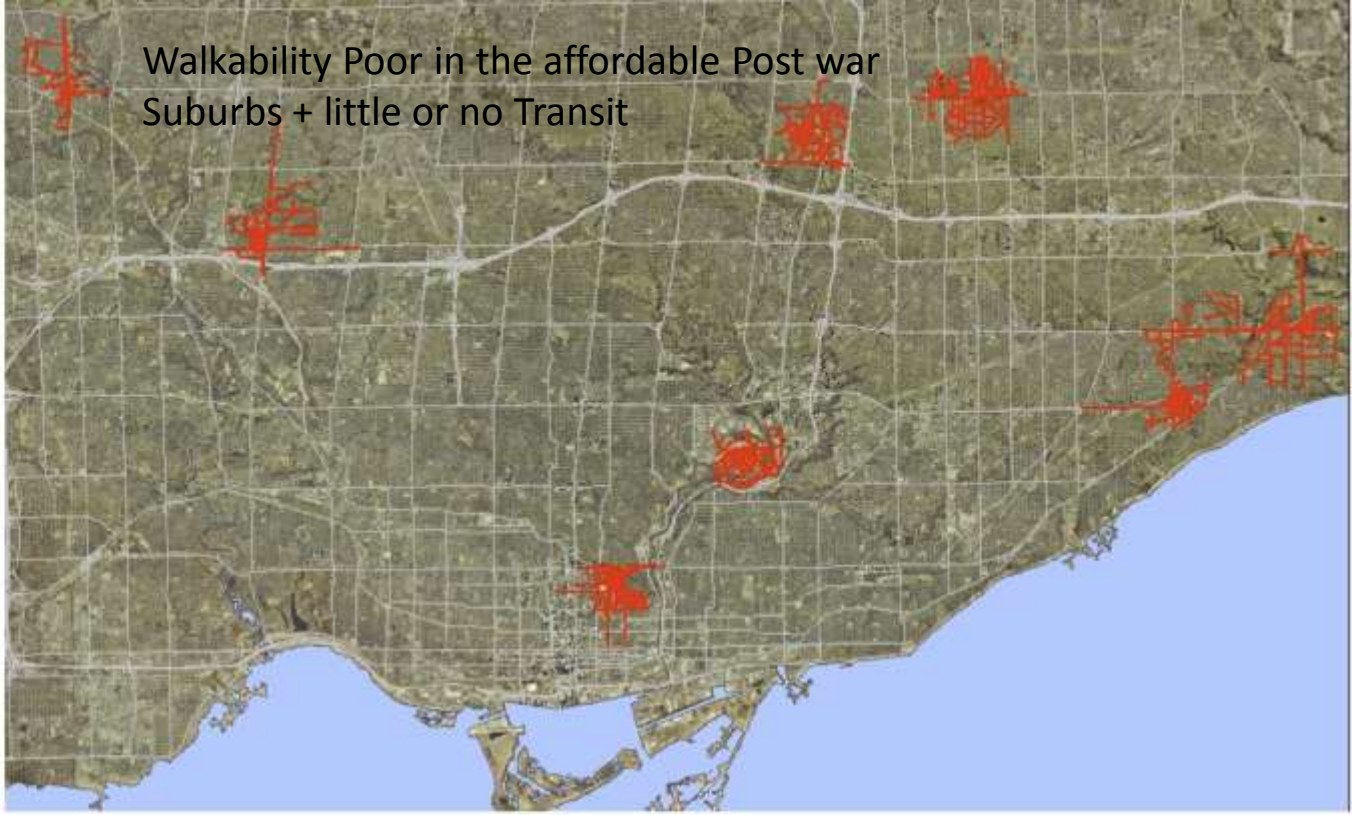
Thanks to a research grant from the Social Sciences and Humanities Research Council, a data analysis team at the University of Toronto's Cities Centre (formerly the Centre for Urban and Community Studies) organized census data at the census-tract level for the Toronto CMA between 1971 and 2006. To avoid confusion with dates, note that incomes reported in the 1971 and 2006 censuses represent those of the preceding calendar years (1970 and 2005).

WHAT HAVE WE FOUND?

Over the course of 35 years, the pattern of who lives where in Toronto on the basis of socio-economic characteristics has changed dramatically. There has been a sharp consolidation of three distinct groupings of neighbourhoods in the city. No

David Hulchanski, Cities Centre, UofT

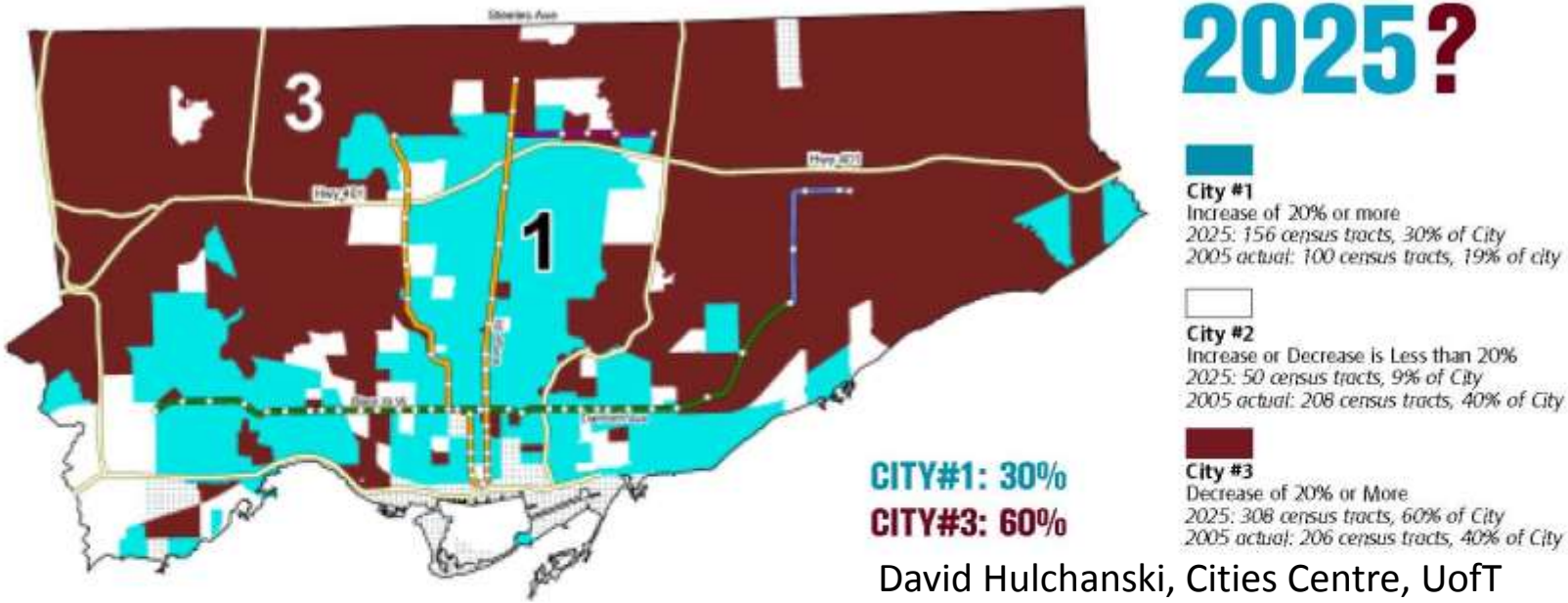
Paul Hess, Cities Centre, UofT



3. Is this a clash of ethics? The Provincial assumption is that their policy will force denser development to make transit more affordable. Until transit is equitably distributed in all neighbourhoods, gentrification based on travel times may displace affordable neighbourhoods again.

MAP 7: PROJECTION OF THE "THREE CITIES" IN TORONTO TO 2025

Based on the 1970 to 2005 Trends in Census Tract Average Individual Income, Assuming No Change in Trends



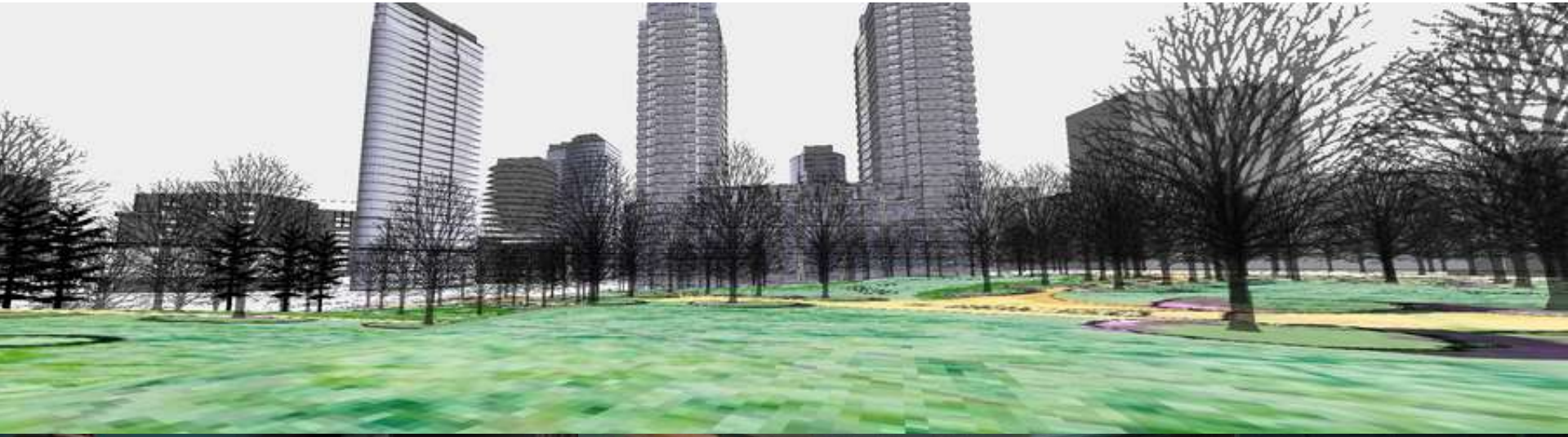
David Hulchanski, Cities Centre, UofT

ers, especially low-income immigrants, who cannot afford housing in the central city or the outer suburbs.

City #1 has grown to cover most census tracts close to the north-south and east-west subway lines. By 2025, these census tracts will

"Three Cities" model is approaching a "Two Cities" model, in which neighbourhoods are sharply divided between those in which average individual incomes have increased dramatically over the 1970 to 2025 period and neighbourhoods where the opposite has occurred.

access grid - student review with NZ – Hoinkes, Danahy, Lindquist



CLR Community Workshops – Toronto Rail Lands and Waterfront Friends of Fort York

THE PROCESS » VISIONING SCALE & PROGRAM OPPORTUNITIES

The design vision process began by using the digital tools with lay people to facilitate spatial thinking. It provided the ability to place two and three dimensional scale models of well established design and economic precedents proved extremely valuable in analyzing the scale of the site and the program elements under discussion. The process began with two dimensional imaging and progressed to three dimensional models as the conversation and spatial dialogue evolved toward consensus or shared agreement.

The West Don Lands project by Waterfront Toronto was used extensively (both visually and numerically) to demonstrate to authorities that these ideas are buildable in the Greater Toronto context.

Pictured at right are a samples of the many examples and precedents people asked to see to scale on the site. The large image is a hybrid 3D site collage of Waterfront Toronto's West Don Lands and elements of the Chicago waterfront elements. Below are Toronto Zoo (top left), Granville Island, Vancouver (top right), Mississauga City Centre (bottom left), Ontario Place, Toronto (bottom right).

THE PROCESS » DESIGN VISIONING TO DEMONSTRATE FEASIBILITY

The interactive software allows people to calculate population and density while studying how to maintain "sky views" and a healthy tree canopy in the major public boulevards. The 135 degrees of sky view was possible to achieve in the boulevard by stepping back the massing to let light to the trees and the street and establish the "sky view" so important to people.

A key point illustrated in this document about the research and method is that a very effective professional level of graphic representation can result as a "free" by-product of the real-time conversations using the computer. There is no "photo-shopping" or expensive complicated movie quality CG (computer graphics) imaging. These images are what people saw as they worked. As such the representations are a documentation of the dialogue at the early and conceptual stages.

THE POLITICS » SUPPORT & NEXT STEPS

Typical planning process:

PROVINCIAL GOVERNMENT

↓

MUNICIPAL GOVERNMENT

↓

COMMUNITY

Lakeview Legacy process:

MUNICIPAL GOVERNMENT

PROVINCIAL GOVERNMENT

↑ ↑

COMMUNITY

The next stages of implementation are looking more closely at ways to incorporate all of the possibilities of the residents vision as part of the 5 year District Plan and Zoning Review along with a new set of design review policies. The first two steps in this process took place recently with the addition of the Lakeview area to the terms of reference of the City's Urban Design Review Panel and the formation of a new citizen and multi tier government review panel to provide direct input to planning staff on Lakeview.

The community association has formed the Lakeview Legacy Foundation with experts from business, the arts and education to foster the aims of the vision. The foundation is developing an adaptive reuse of a heritage factory as a centre for arts and science. A series of symposiums is planned on topics such as brownfield legislation and mixed use employment to work with the local businesses and development industry.

Now, a new future is supported by the Province and the City

The Citizens' Lakeview Legacy Project becomes endorsed by all levels of government and proceeds as Inspiration Lakeview

The Citizens' Lakeview Legacy Project becomes endorsed by all levels of government and proceeds as Inspiration Lakeview following the City of Mississauga's Strategic Plan Pillars (above)


Issue: How to retrofit the automobile scaled post WWII Canadian Cities as Smart Sustainable Cities?
427
403
401
410
407
Maryfield Rd
Guelph St
Google

Lakeview Legacy Vision Plan sought to restructure the infrastructure and livability of this Post WWII brownfield post industrial community as a smart eco community. The plan was developed over a two year period by the Lakeview Ratepayers Association with support from the CLR-UofT

Lakeview Legacy Vision Plan – A Citizen's Plan empowered by collaboration with the University
Lakeview Ratepayers Association // Centre for Landscape Research, University of Toronto

On October 6 and December 2,3,4, we had very passionate idea exchanges during public engagement – Inspiration Lakeview

Visualizing the follow-up professional plan in the Citizen's Base Model for comparison and negotiation. Professional model (Urban Strategies) was a 15 foot long physical process model but lacked detailed digital metrics and context. Centre for Landscape Research, UofT

Master Plan & Indicator

Indicators and Metrics
Total Area: 1.14 ha
Population: 12,306
Density: 10,978 ppl/ sq. km
Dwelling Units: 6,250
Average Household Size: 2 people / household
Parking: 1.1 / unit
Business: 38/1000 person
Employment: 2,500
Tree Canopy: 20 %
Travel Time to Transit Stop: <=3 min

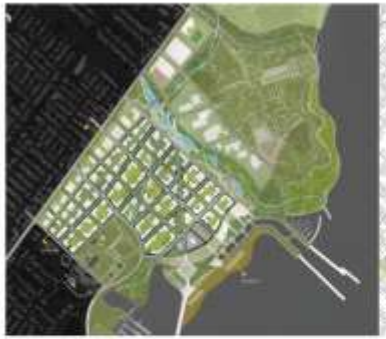
Total Area: 100 hectares
Population: 12,000 - 15,000
Population Density: 120 - 150 persons/hectares
Dwelling Density: 520 - 650 dwelling units/ hectares
Parking: 1.2 spaces/dwelling unit
Tree Canopy: 11.3%
Pervious/Impervious: 78.2%/20.8%
Average Household Size: 2.3-2.5
Retail Intensity: 100 Businesses/1000 persons
Real Estate Values: residential $4000 - $5000/m2
Business Type Morphology: grocery store (No Frills),
Shoppers Drug Mart, bank,
omt, hair salon, cafe, bar,
restaurant
Jobs: 1500-1800

Travel Time to Transit Stop: 3 minutes
Travel Time to Mississauga City Centre: 05 minutes
Travel Time to GO Station: 5 minutes to Long Branch
15 minutes to Port Credit
Travel Time to Toronto Downtown: 40 minutes

Urban Ecology Tree Canopy
(19.2% land area)
Pervious/Impervious (73.3%pervious)
Urban Density, Form, Program
Total Popula on (12,000
Popula Density (120/hectare)
Dwelling Density (52 units/hectare)
Parking (1.3spaces/dwelling unit)
Demographics Social/Tr cal Age
Pyramids (29% 55+ ; 20% 0-19)
Income Distri on
Average Household Size: 2.3
Urban Economics Retail Intensity
(23.3of Businesses/1000 persons)
Real Estate Values ($5000/m 2)

Business Type Morphology(refer to land use)
Jobs (1,200 total employment)
Urban Transporta on Travel Time to Transit Stop 5-1min
Travel Time to Mississauga City Cen- tre20min
Travel Time to GO S on (5-15min
Travel Time to Toronto Down- town30-40min

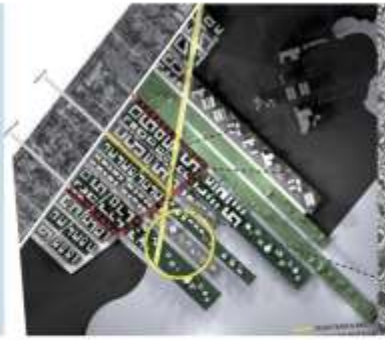
Tree Canopy : 25%
Impervious / Pervious: 57% / 43%
Expected Population: 12200
Population Density: 122 people / hectre
Dwellings: 4180 units
Building Typology: Apartment Building
# of Businesses: 80
Jobs: 1500+
Local Bus Routes and Holiday and Event Bus Routes



Residential: 656,146
Commercial: 46,688
Cultural & Entertainment: 28,133
Office: 87,225
Green Space: 621,088
Institution: 10,081
Public Square: 47,776
Parking: 120,000
Aquatic: 120,000
Industrial: 31,085

Population: 15,000
Household Units: 6,000
Vehicles: 6,000 (1 per household)
Retails: 147
Institution: 1
Library: 1
Gallery: 1
Community Center: 5
District Energy: 1
Supermarket: 1
Sport Center: 1
Shopping mall: 2

Total Area: 100 ha
Population: 10,680 - 12,650
Density: 106 -126ppl/ha
Dwelling Units: 5,300 - 5,500
Household Population: 2.3
Parking/Spaces/Dwelling Units): 1 (reduce from typical 2)
Retail Units: 150
Employment: 1,800 - 2,200
Tree Canopy: 30% - 35%
Travel Time to Transit Stop: <=3 min

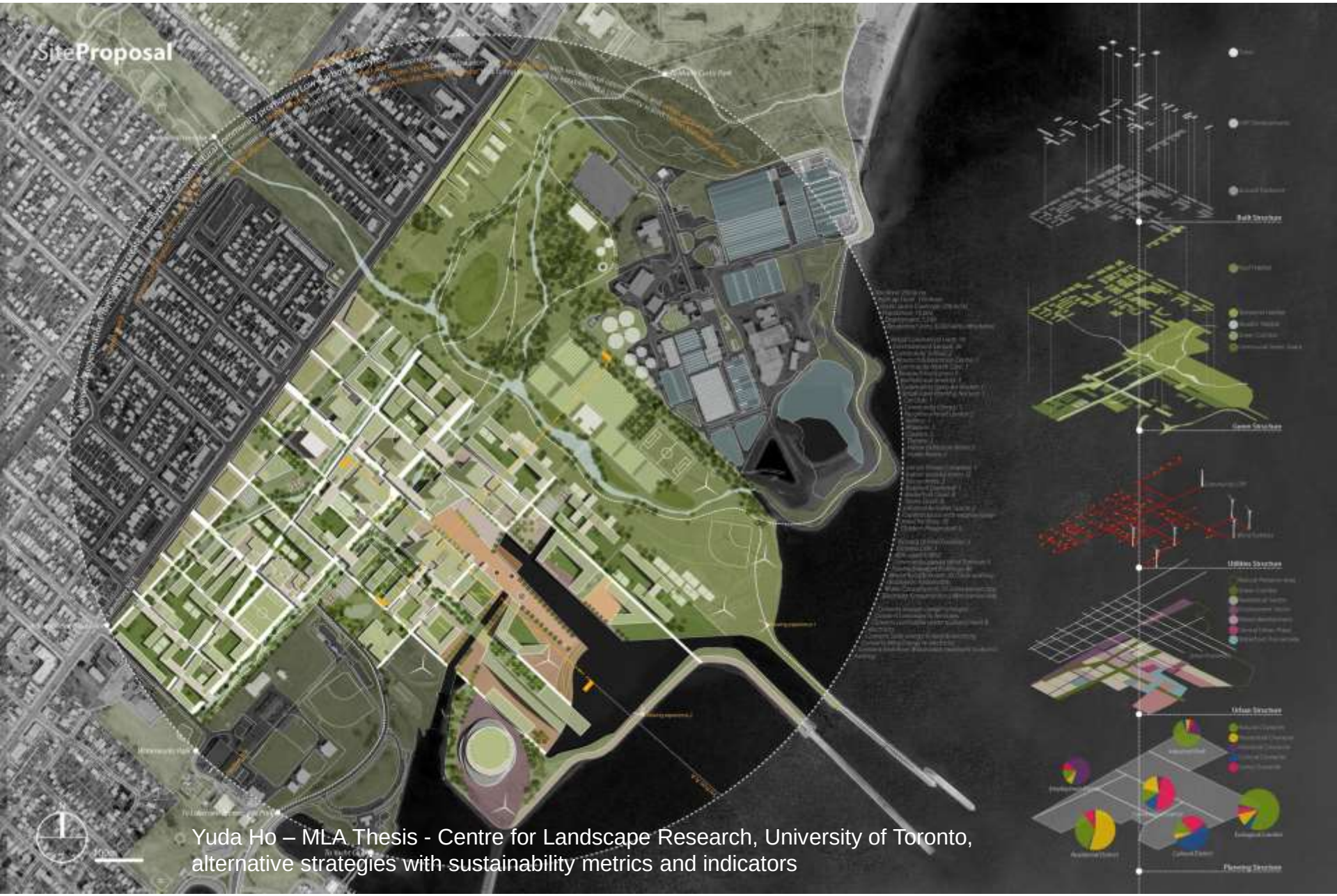


Total Area: 100 ha
Population: 15,000
Density: 37 ppl/ha
Dwelling Density: 110
Parking: 22,000
Retail Units: 150
Real Estate Value: 4000 per square meter
Employment: 1,800 - 2,200
Tree Canopy: 18%
Travel Time to Transit Stop: <=3 min
Jobs: 6,500
Age Pyramid:
0-19: 17% 20-24: 8% 25-39: 35.7% 40-46: 34.7% 65+: 10.8%

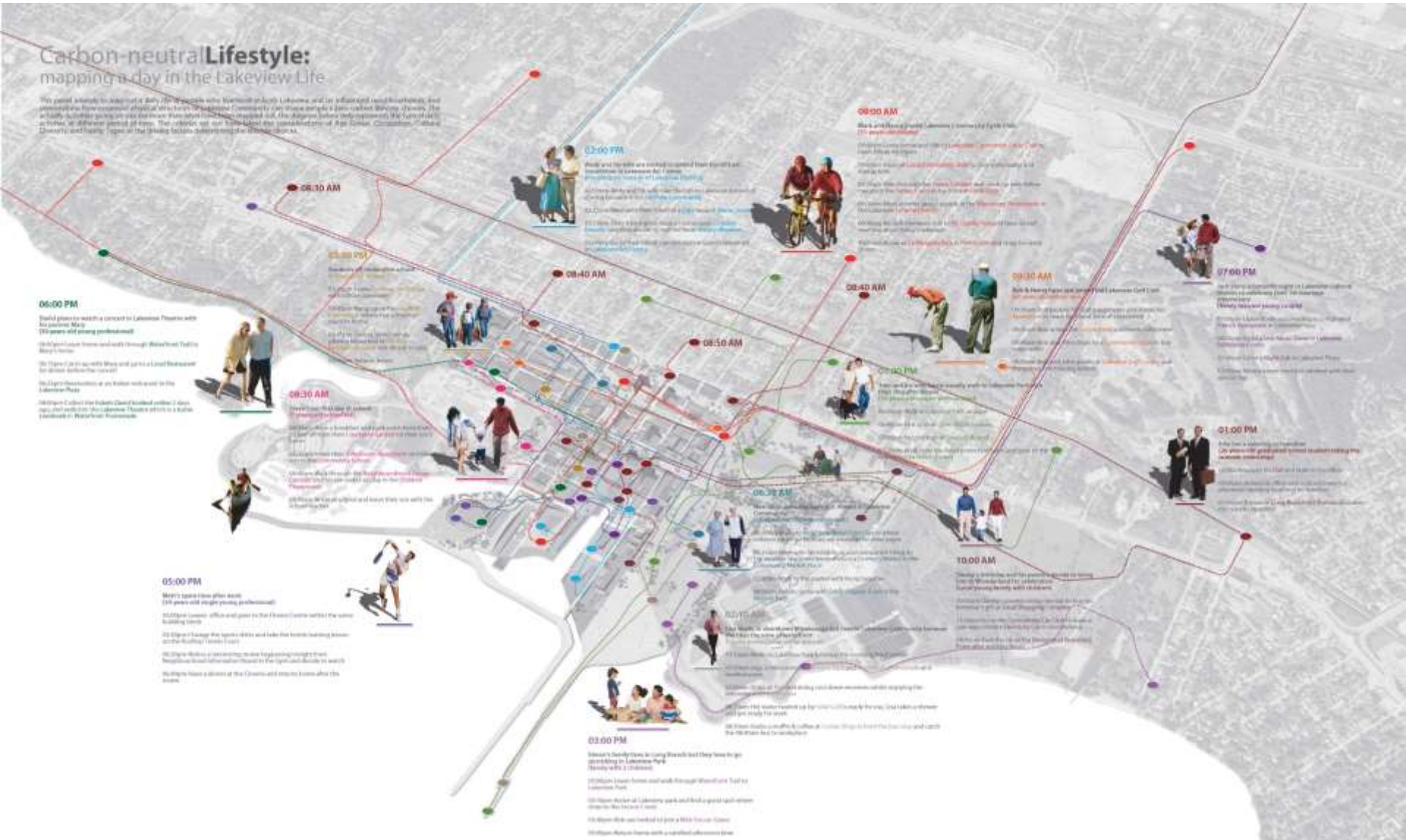
Total Area: 100 hectares
Population: 12,000 - 15,000
Population Density: 120 - 150 persons/hectares
Dwelling Density: 520 - 650 dwelling units/hectares
Parking: 1.2 spaces/dwelling unit
Tree Canopy: 11.3%
Pervious/Impervious: 78.2%/20.8%
Average Household Size: 2.3-2.5
Retail Intensity: 100 Businesses/1000 persons
Real Estate Values: residential $4000 - $5000/m2
Business Type Morphology: grocery store (No Frills),
Shoppers Drug Mart, bank,
omt, hair salon, cafe, bar,
restaurant
Jobs: 1500-1800
Travel Time to Transit Stop: 3 minutes
Travel Time to Mississauga City Centre: 05 minutes
Travel Time to GO Station: 5 minutes to Long Branch
15 minutes to Port Credit

Total Area: 100 ha
Population: 11,088
Density Units:5,100
Dwelling Density: 5014
Business: 6266 employment
Parking: 22,000
Retail Units: 3,668
Office: 68
Tree Canopy: 14.7%
Employment: 1,800 - 2,200
Tree Canopy: 18%
Travel Time to Transit Stop: <=3 min
Jobs: 13,000

Centre for Landscape Research, University of Toronto, Graduate MLA, March and MUD students developed alternative strategies with sustainability metrics and indicators.



Yuda Ho – MLA Thesis - Centre for Landscape Research, University of Toronto, alternative strategies with sustainability metrics and indicators



Yuda Ho – MLA Thesis - Centre for Landscape Research, University of Toronto
strategies for examining sustainable lifestyle factors and site considerations


SERSON CREEK CONTAMINATION SOURCES

Serson Creek's Watershed Management Strategies

Residential Area

Source Control
- Permeable Driveway + Detention Trench
- Stormwater Infiltration Basin System
- Downspout Disconnection
- Bioswale Conveyance Network
- Stormwater Drainage Network

Stormwater Quality Management

End-of-Pipe Control
- Wet Pond System

Flood Protection Dike

CN Rail Bridge

Flood Risk Management

North-south Connection to Waterfront

Light Industrial & Commercial Area

Industrial Area

Previous Coal Pile Site
Site Cleaning
- Brownfield phytoremediation

Constructed Wetland System

New Devlopment -Lakeview Model
- Non Defensive Flood Risk Management
- Multiple Function Open Space

Creek Mouth Marsh Rehabilitation

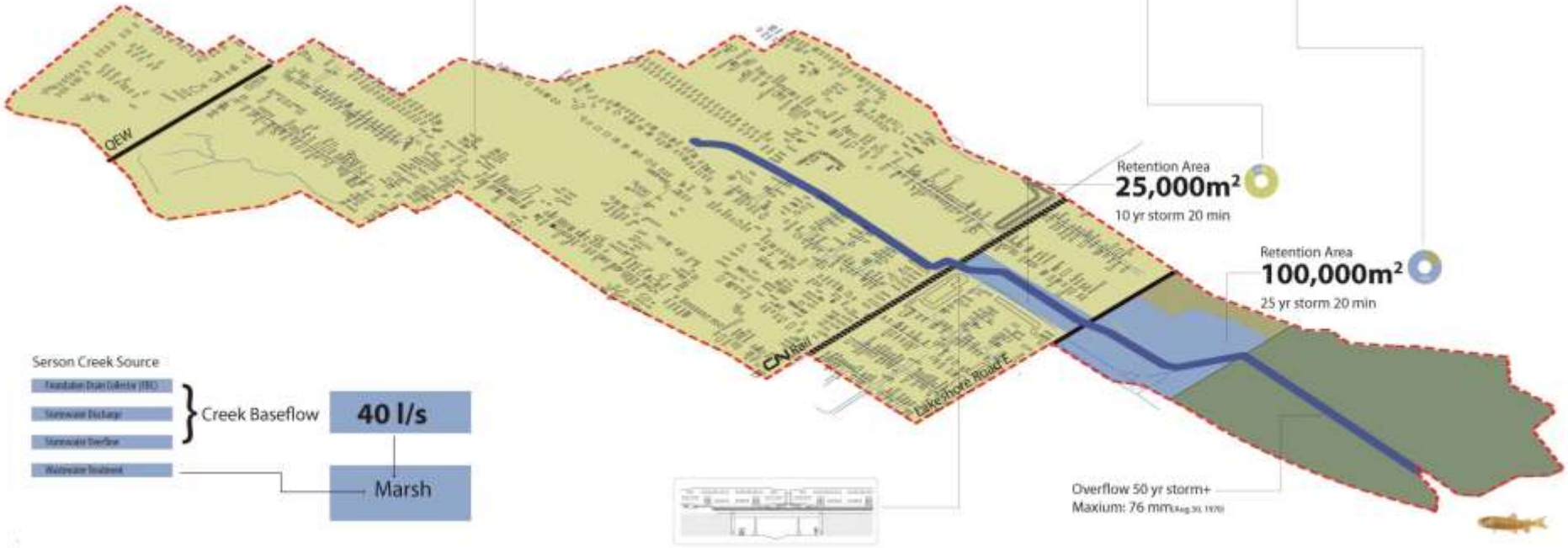
Water Quality Deterioration

Perodic Flooding

Loss of Creek Mouth Marsh

Total Retention Area
125,000m²

First Flush: 25 mm Rainfall



Retention Area
25,000m²
10 yr storm 20 min

Retention Area
100,000m²
25 yr storm 20 min

Serson Creek Source
- Foundation Drain Collector (FDC)
- Stormwater Discharge
- Stormwater Overflow
- Wastewater Treatment

Creek Baseflow **40 l/s**

Marsh

Overflow 50 yr storm+
Maxium: 76 mm (Aug 30, 1970)

Residential Unit Stormwater Management Strategies

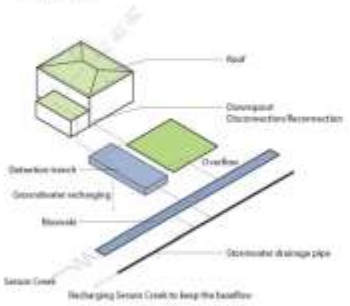
Proposed Stormwater System

Reduce surface runoff

Permeable Paving
Downspout Disconnection
Bioswale

Filter and store first flush -25mm

Permeable Paving
Detention Trench

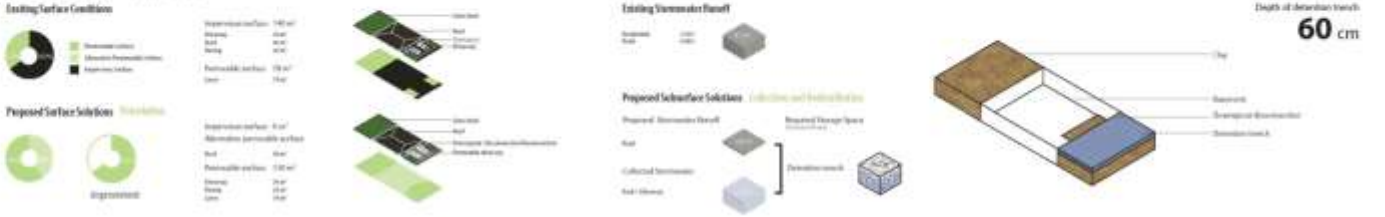


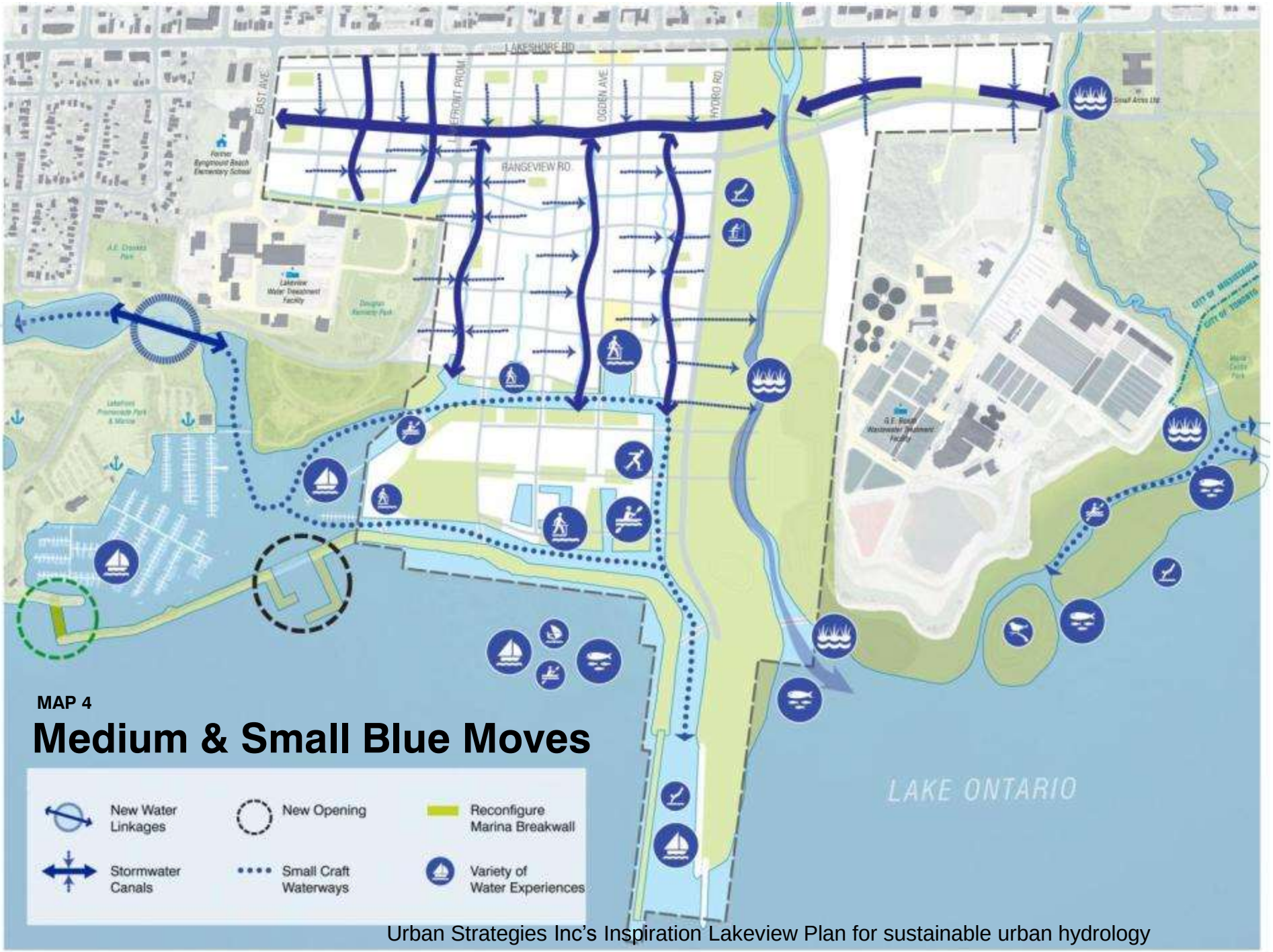
1 Low Density - Detached House Type 1

2 Low Density - Detached House Type 2

3 Medium Density - Semi-detached House

4 Medium Density - Townhouse

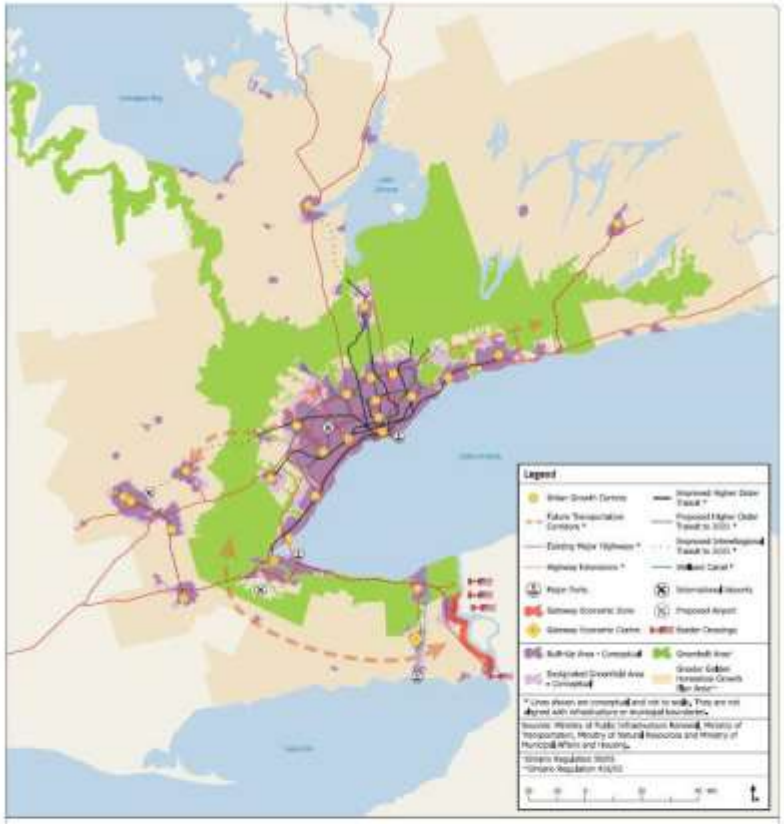




Urban Strategies Inc's Inspiration Lakeview Plan for sustainable urban hydrology

a proposed way that KMDI and Cities Centre at UofT could collaborate on smart cities research

GGH Places to Grow Conceptual Map



Note: The information displayed on this map is not to scale, does not accurately reflect approved land use and planning boundaries, and may be out of date. For more information on precise boundaries, the appropriate municipality should be consulted. For more information on Greenbelt Area boundaries, the Greenbelt Plan 2005 should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.

Growth Plan for the Greater Golden Horseshoe

The Plan sets out a framework to provide overall leadership and guidance to municipalities as they plan for growth in their communities.

The Growth Plan has four major sections:

1

WHERE AND HOW TO GROW

- Growth Forecasts
- Managing Growth
- General Intensification
- Urban Growth Centres
- Major Transit Station Areas and Intensification Corridors
- Employment Lands
- Designated Greenfield Areas
- Settlement Area Boundary Expansions
- Rural Areas

2

INFRASTRUCTURE TO SUPPORT GROWTH

- Infrastructure Planning
- Transportation – General
- Moving People
- Moving Goods
- Water and Wastewater Systems
- Community Infrastructure

3

PROTECTING WHAT IS VALUABLE

- Natural Systems
- Prime Agricultural Areas
- Mineral Aggregate Resources
- A Culture of Conservation

4

IMPLEMENTATION

- Places to Grow Act, 2005
- Implementation Analysis
- General Implementation and Interpretation
- Coordination
- Monitoring and Performance Measures
- Public Engagement

The following pages provide an outline of the concepts, rationale and principles of some of the key policy directions in each of these sections to assist in understanding the Growth Plan.

GGH Urban Growth Centres (Visualization of density targets)

150 PEOPLE AND JOBS COMBINED PER HECTARE BY 2031

- Downtown Barrie
- Downtown Brantford
- Downtown Cambridge
- Downtown Guelph
- Downtown Peterborough
- Downtown St. Catharines

200 PEOPLE AND JOBS COMBINED PER HECTARE BY 2031

- Downtown Brampton
- Downtown Burlington
- Downtown Hamilton
- Downtown Kitchener
- Uptown Waterloo
- Markham Centre
- Downtown Milton
- Mississauga City Centre
- Newmarket Centre
- Midtown Oakville
- Downtown Oshawa
- Downtown Pickering
- Richmond Hill/Langstaff Gateway
- Vaughan Corporate Centre

400 PEOPLE AND JOBS COMBINED PER HECTARE BY 2031

- Downtown Toronto
- Etobicoke Centre
- North York Centre
- Scarborough Centre
- Yonge-Eglinton Centre

The Complete Street

Stirling, &Co

The goal of the GEOIDE TSII#201 project

Connecting

urban design and performance models

in a visual environment for decision making in urban sustainability

Integrated Decision Support for Sustainable Communities

October 5, 2010

Cities Centre
UNIVERSITY OF TORONTO

Research Leadership

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John Danahy, John H. Daniels Faculty of Architecture

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Bryan Karney, Dept of Civil Engineering, UofT

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Gerald Penn, Dept of Computer Science, UofT

Konstantinos N (Kostas) Plataniotis, Dept of ECE, UofT

Frank Tompa, School of Computer Science, UofW

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- Ted Kesik, UofT
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- Jacob Mitchel, UofT, DTAH
- Eugene Mohareb, UofT

RESEARCH PARTNERS

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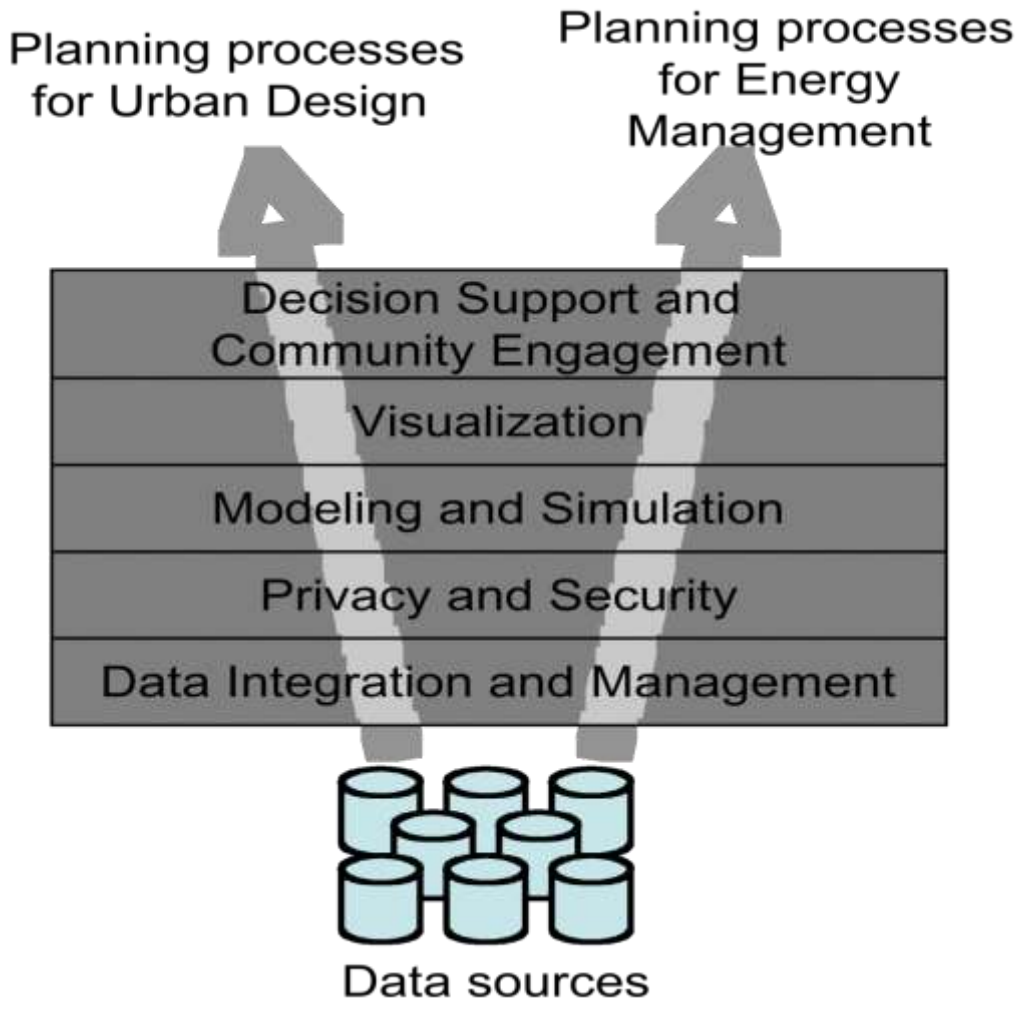
- ESRI Redlands, Bill Miller
- Toronto Regional Conservation Authority
- Waterfront Toronto
- City of Richmond
- City of Surrey
- Dutoit Alsopp Hillier
- Halsall Associates
- Autodesk Canada

Research Overview



Research Themes

- Data Integration and Management:
  - Handling very large datasets, containing disparate sources and types of data;
- Privacy and Security:
  - Protecting the privacy of all citizens in data that capture increasingly more detail about everyday activities, while making that data accessible for research and analysis;
- Modeling and Simulation:
  - Designing and testing optimal methods for visualizing complex spatial, temporal, socio-economic patterns for research and decision-making purposes;
- Visualization:
  - Creation of collaborative and immersive visualizations for decision making for government, private sector and communities;
- Decision Support and Public Engagement:
  - Participatory design, social networking, and interactive engagement of decision makers at all levels.

Partners

Universities

- University of Toronto
- University of Waterloo
- Ontario Institute of Technology

Research Programs:

- NSERC Business Intelligence Network

Public Sector

- Independent Electricity System Operator (IESO)
- Ontario Power Authority
- Toronto District School Board
- Ontario Centres of Excellence
- Sue Sault Marie Innovation Centre
- Neptis Foundation

Private Sector

- IBM Canada
- Zerofootprint
- Palomino
- Archestra
- Parallel Worlds

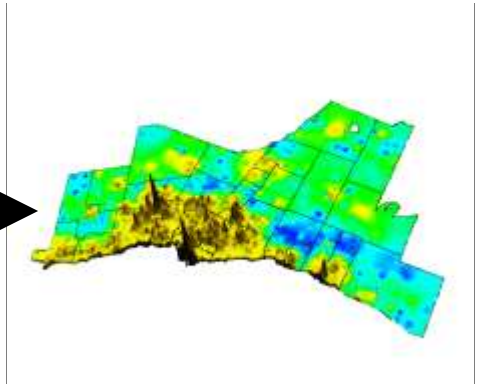
Government

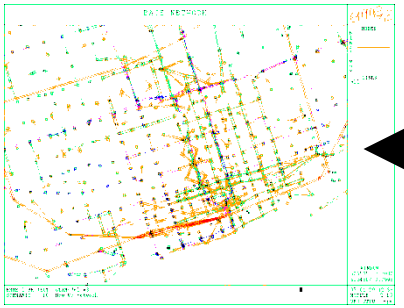
- City of Toronto
- Office of the Information and Privacy Commissioner of Ontario
- National Sciences and Engineering Research Council of Canada (NSERC)

Smarter Planet: Smart Cities

- Municipal decision-making must be informed by strategic plans, watershed plans, official plans, district plans, business improvement plans, heritage strategies, zoning plans, special study plans, urban design guidelines, design review panels
- These are communicated in a multitude of ways including maps, physical and digital models
- Integration of data across scale and scope including location, geographic and planning data is necessary to support decision-makers
- Cities have complex networks of stakeholders to engage in decision-making, each with their own perspectives, needs and language

Typology of Models





Spatial – Temporal Representation of the Physical World
(buildings, transport networks, etc.)

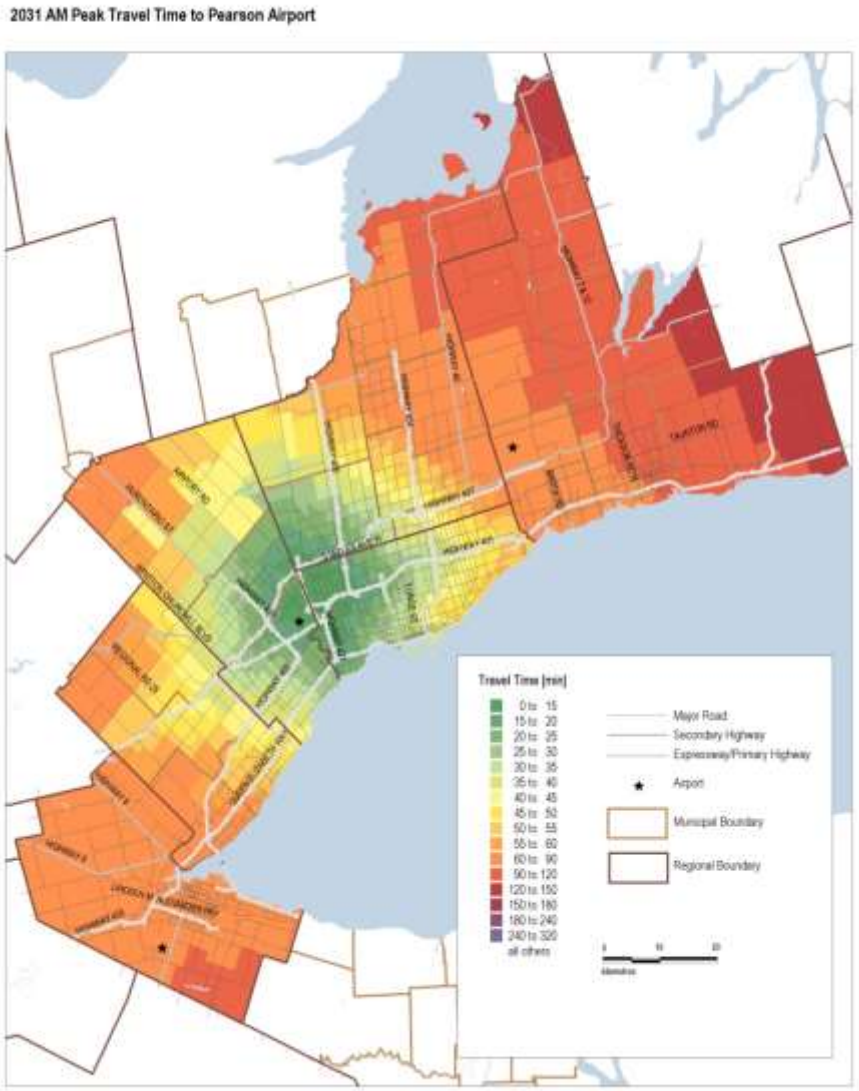
Macro Processes
(regional economy, …)

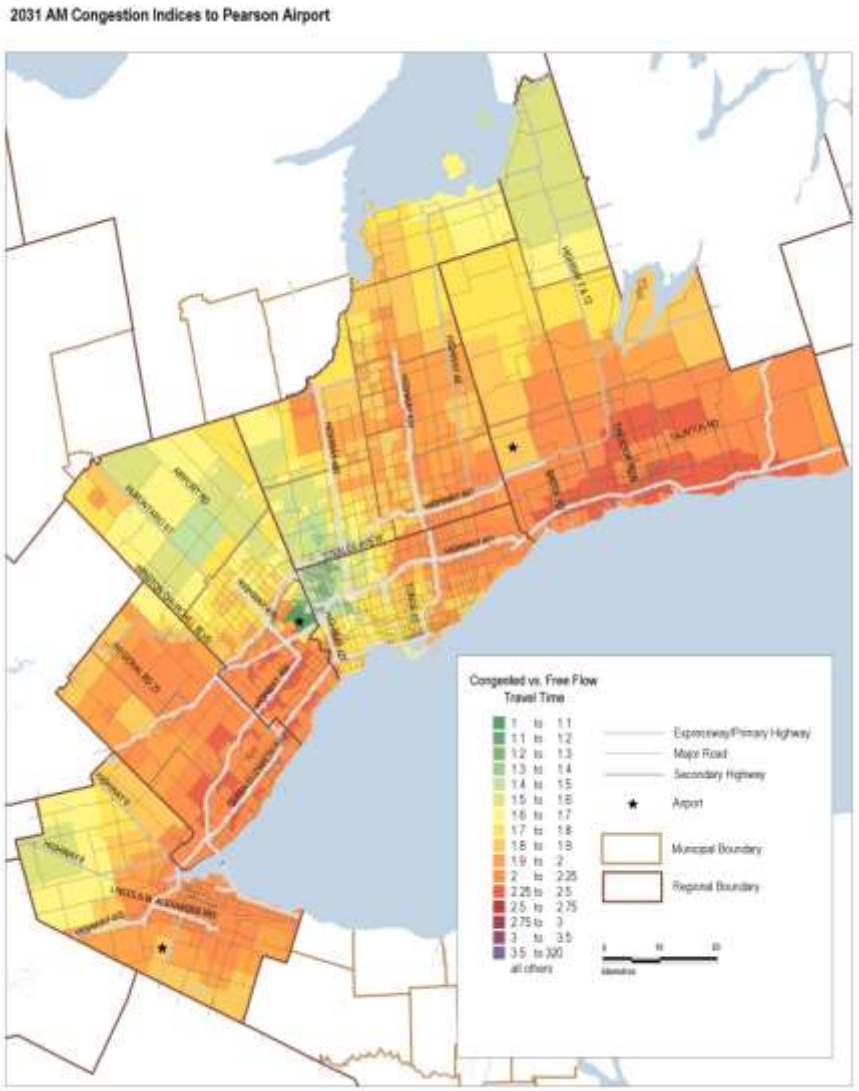
Market Interactions
(demand, supply, prices)

Technology Performance
(energy, road congestion, etc.

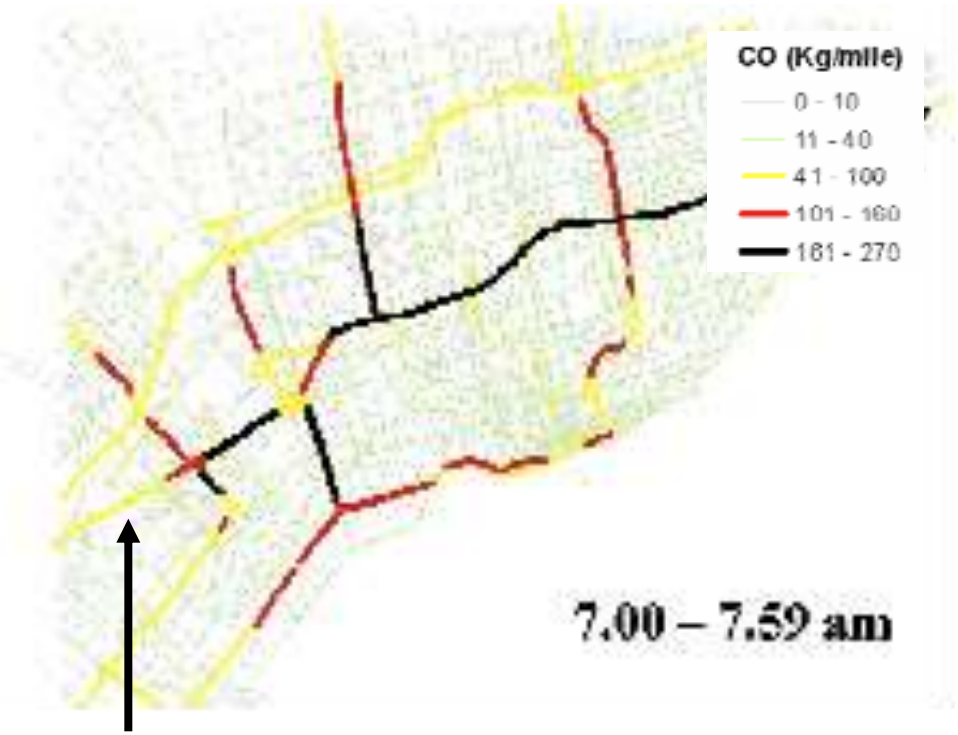
Individual Agents' Actions
(travel, demographics, etc.)

Transportation systems models

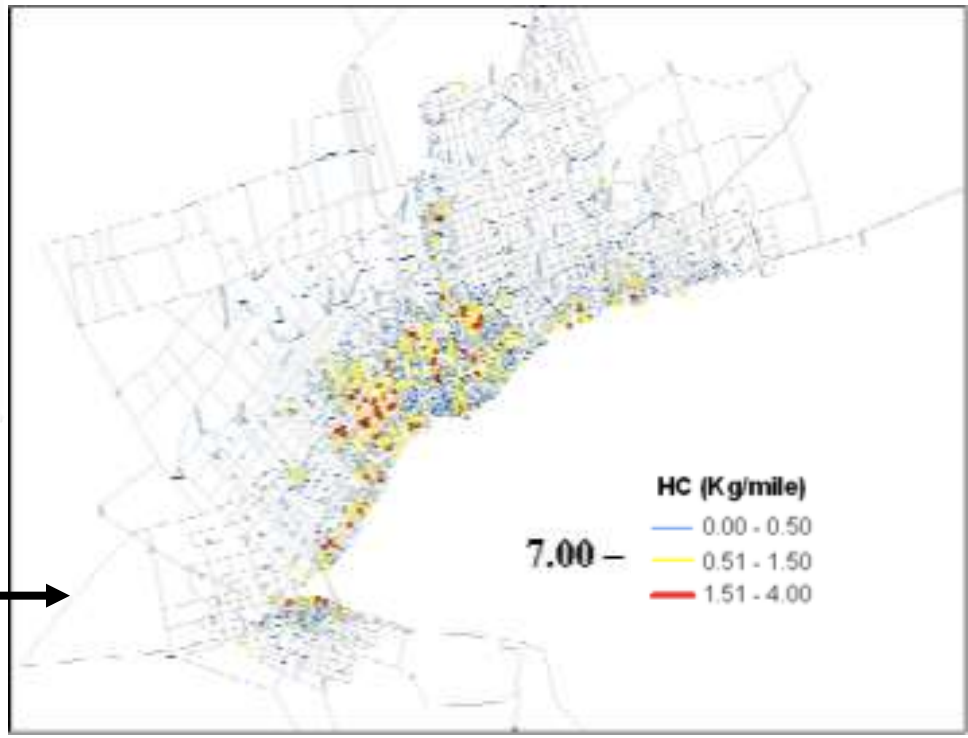




Auto Emissions by location and time of day



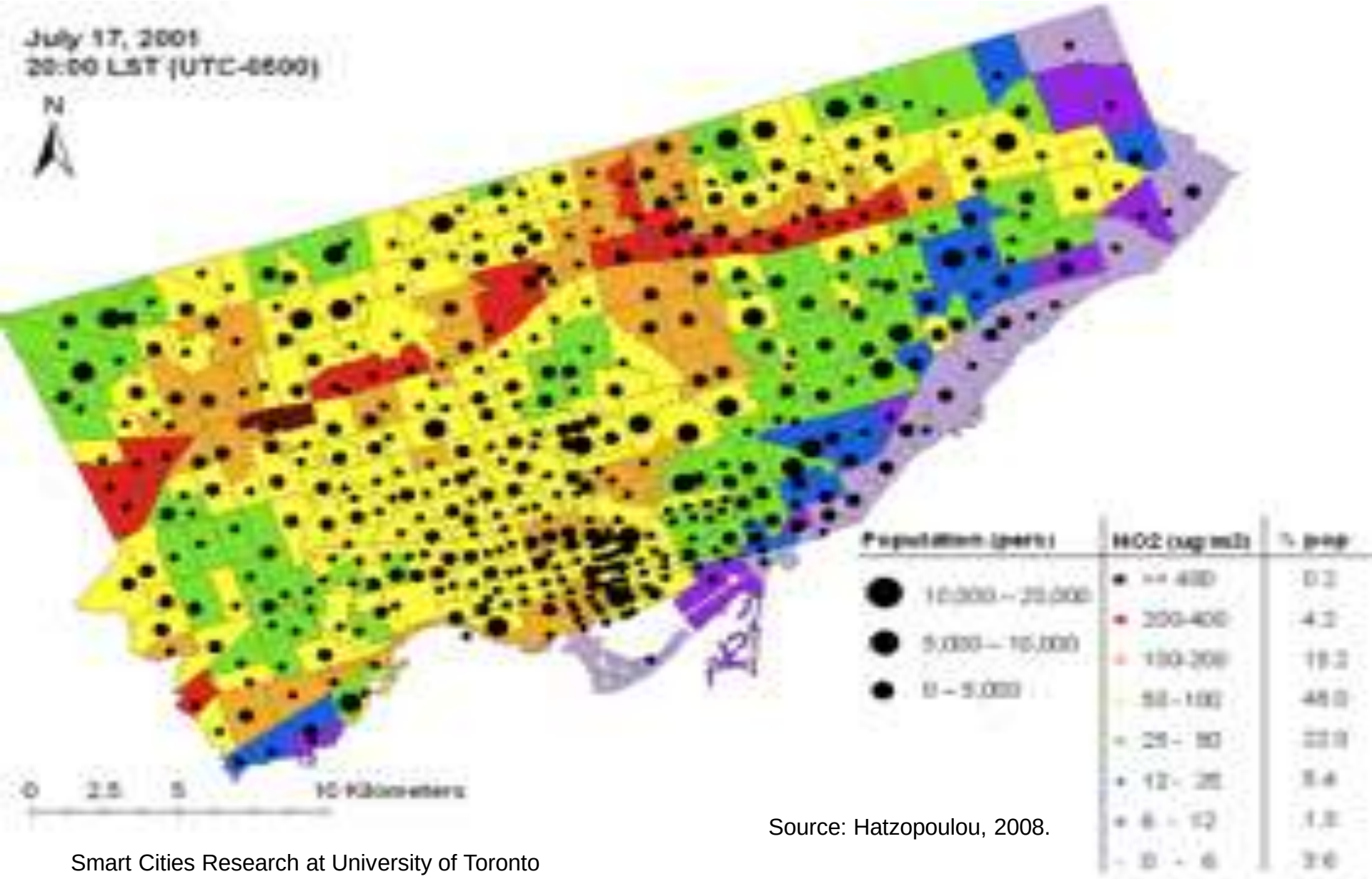
Link-based running emissions by time of day



Zone-based soak emissions by time of day

Source: Hatzopoulou, 2008.

Pollution exposure by location & time of day



Source: Hatzopoulou, 2008.

The Greater Toronto Areas - GTA

- *The GTA & GGH is a large metropolitan region that lacks a coherent regional GIS suitable for sustainability decision making processes*
  - *We aim to connect disparate urban design and evaluation models in a visual environment for decision making in urban sustainability*
  - *Today I am illustrating a case study of the Waterfront Toronto on the West Don Lands*
    - *show the first protoype integrating street scale drawings, 3D max, and a carbon-energy evaluation tool*
  - *As time permits, I will show aspects of the Pearson Airport Eco Industrial Zone case study*

Carbon Tool/GBR Team

Target Range Exercise – Land-Use

Transit Oriented Development

City of Toronto

96% of households are within 400m of a TTC station

Walkability

City of Toronto

~45% of housing units are within 800m of at least 5 basic services

Jobs within 800m of housing: ~50% of housing unit count

Urban Design Models

URBAN DESIGN MODELS

- Master plan: streets, parcels, public realm
- Building footprint and heights

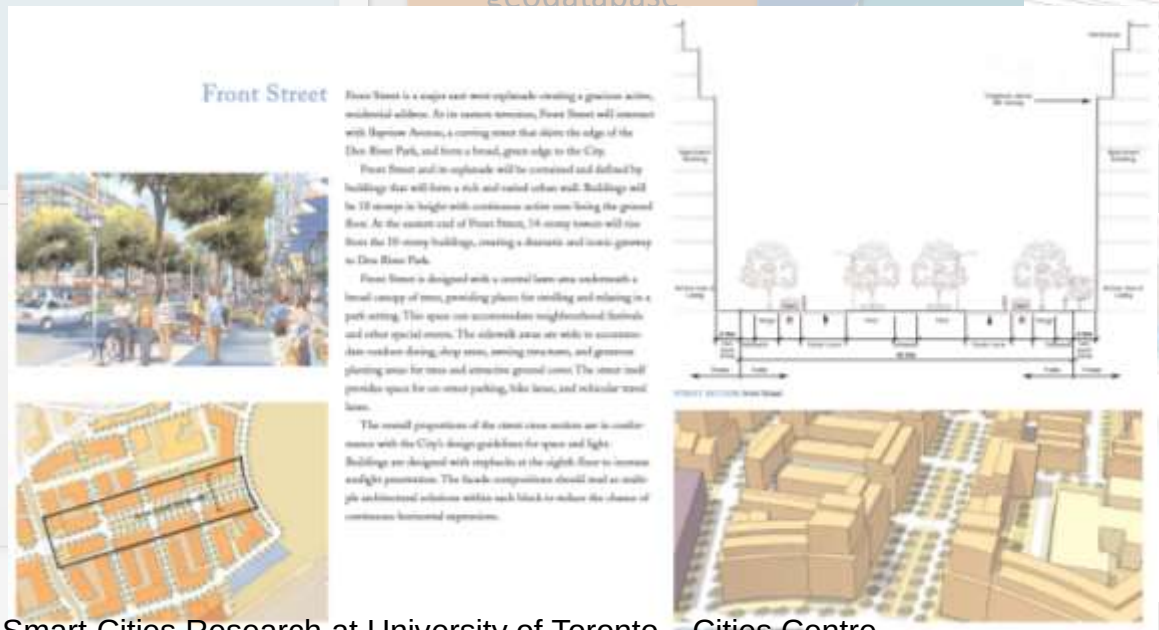
CAD

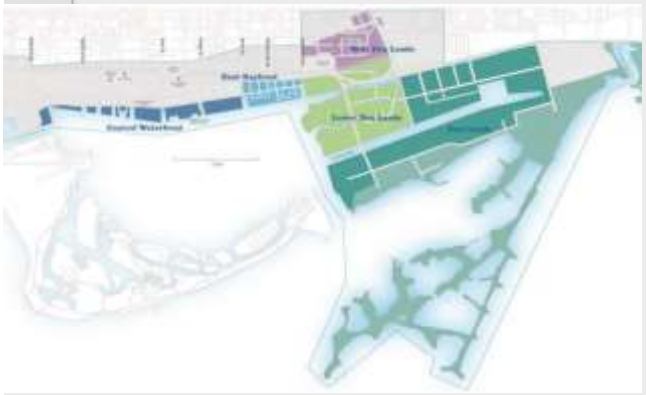
Case Study:
West Don Lands Urban Design and Master Plan

Create common geodatabase

ARC GIS

SPATIA





Urban Performance Models

Traffic Model

Population model (population synthesis)

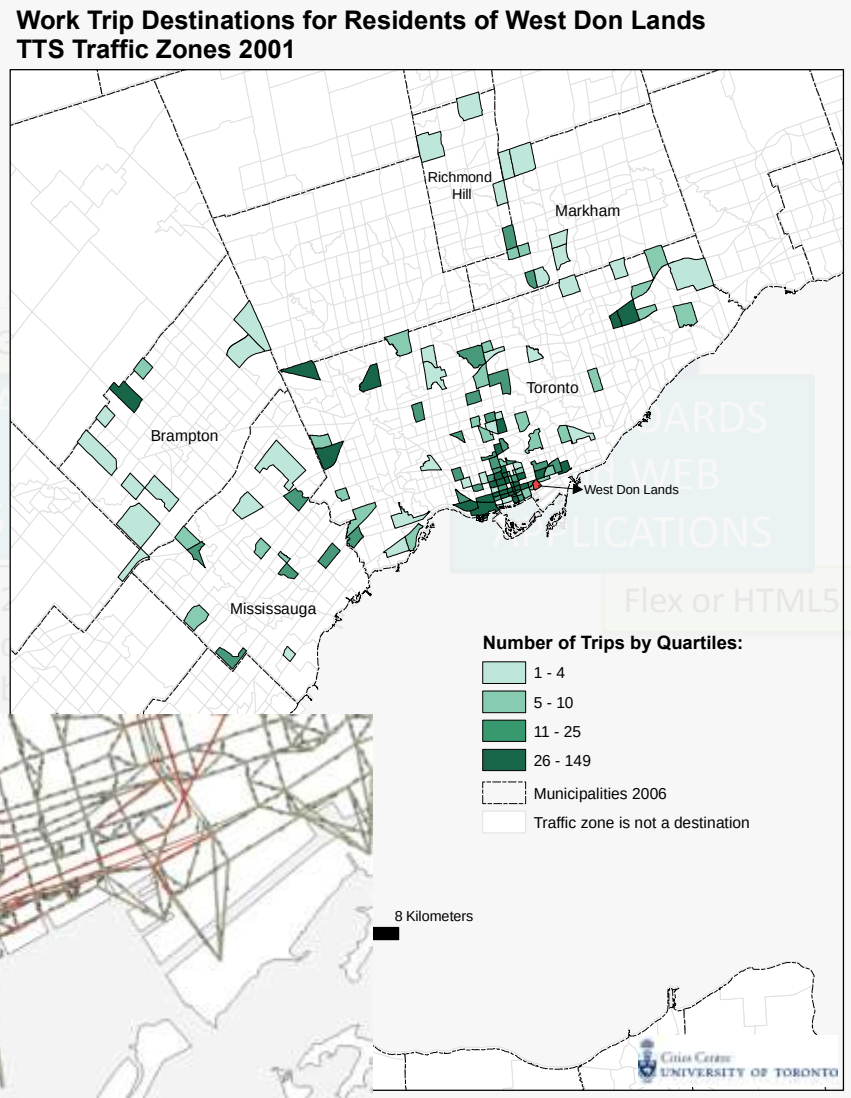
TASHA : Trip Planning

EMME2: Traffic Assignment

URBAN PERFRMANCE MODELS

- Census data
- Traffic Models
- Building Resource Models
- Neighborhood Carbon Model

Excel + software



Urban Performance Models

Traffic Model

Building Resource models

Carbon Model

Regional Carbon factors applied to build-out scenarios

Carbon output per resident and building area

URBAN PERFRMANCE MODELS

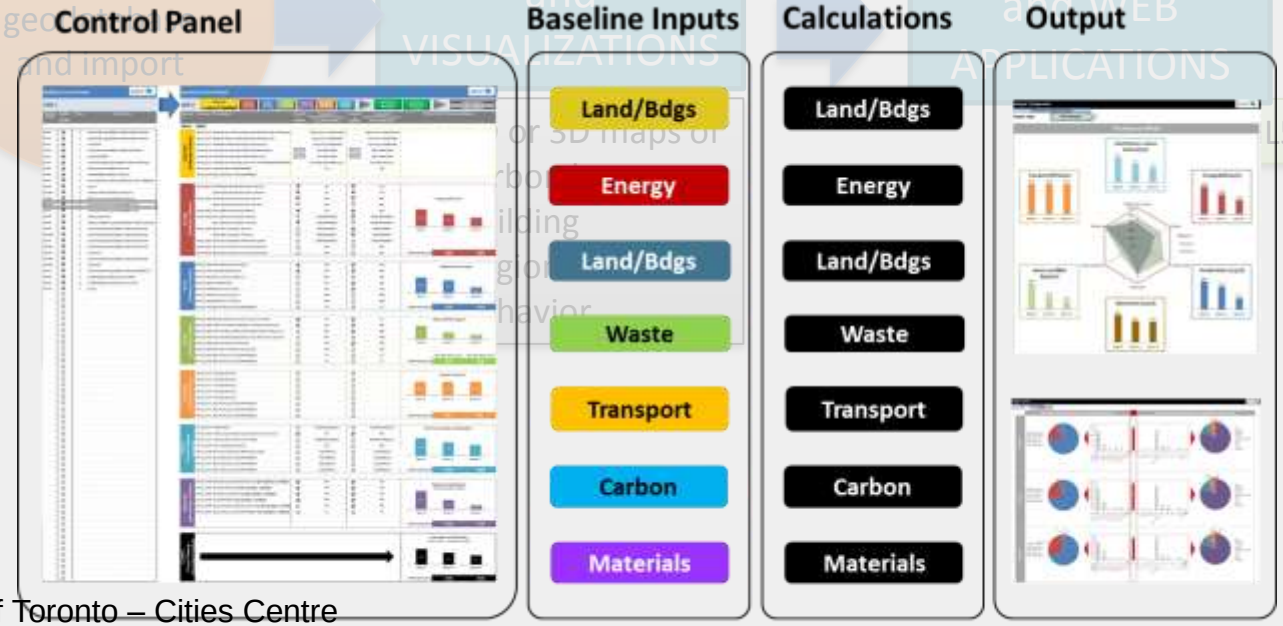
- Census data
- Traffic Models
- Building Resource Models
- Neighborhood Carbon Model

Excel + software

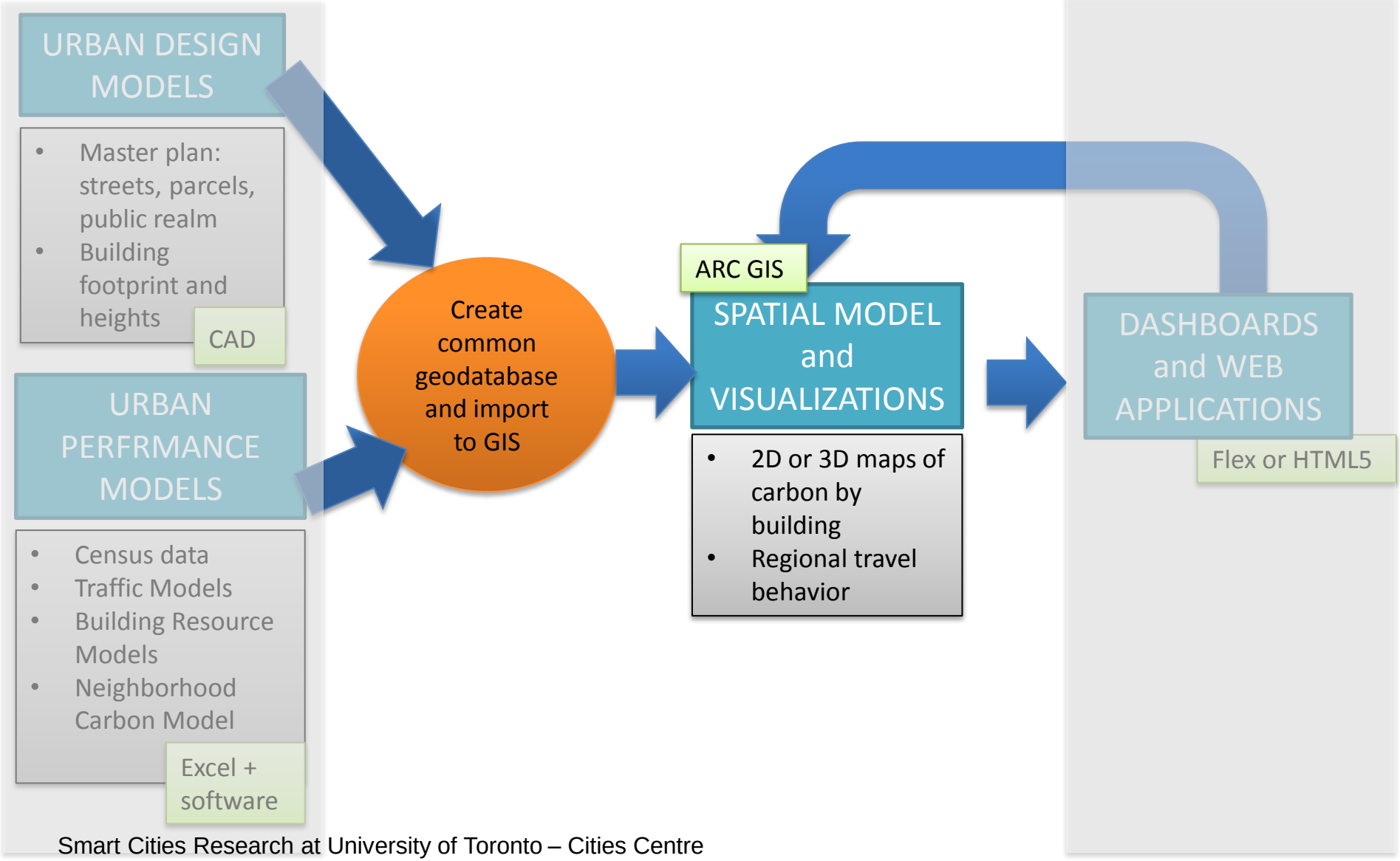
ARC GIS

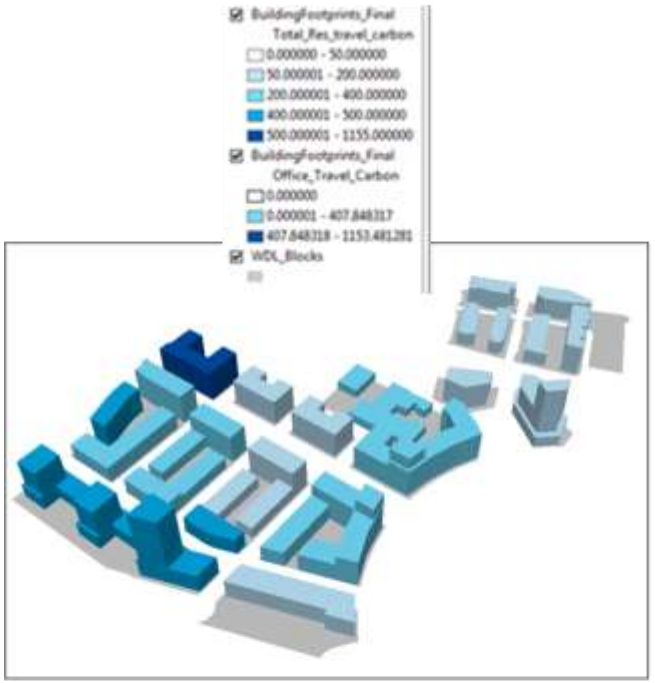
SPATIAL MODEL and VISUALIZATIONS

DASHBOARDS and WEB APPLICATIONS



Spatial Models

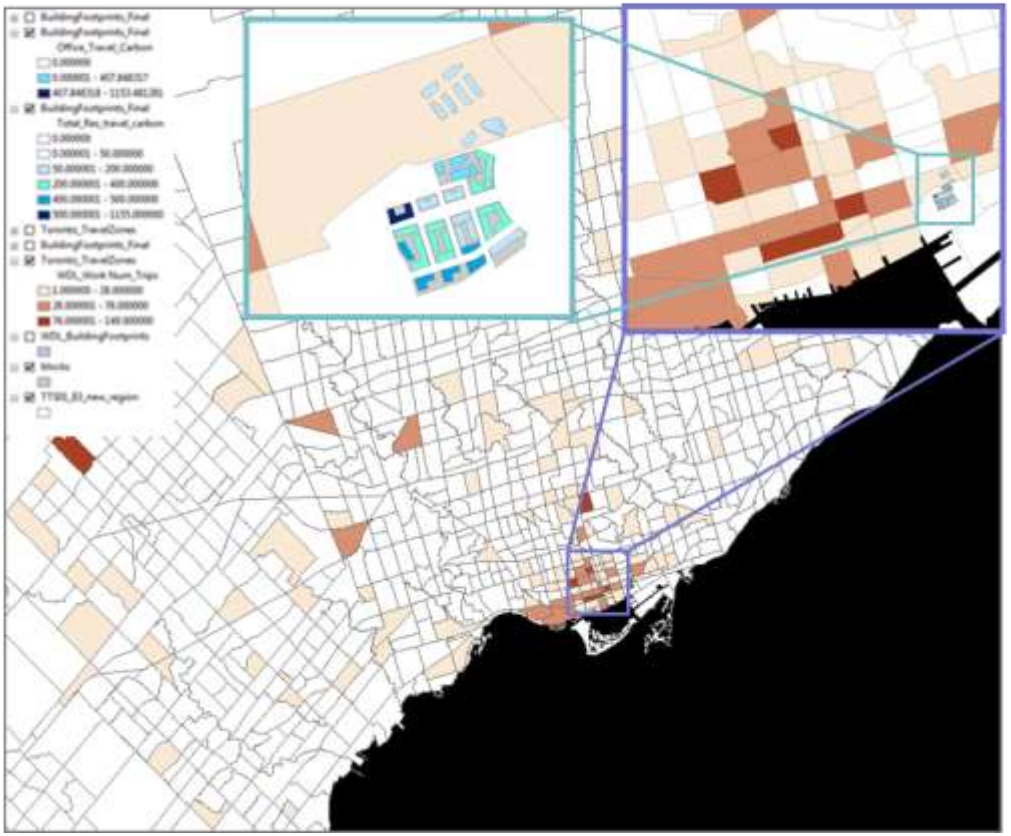




Carbon generated by resident and employee travel (tons CO2)

Destination of resident work trips in the region

(number of trips)



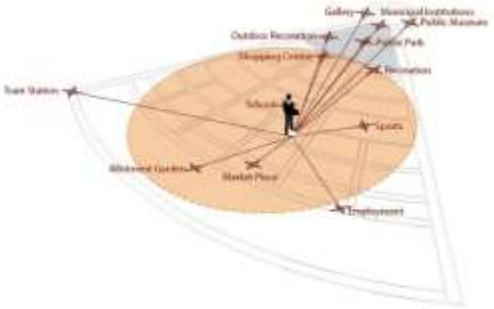
Dashboards

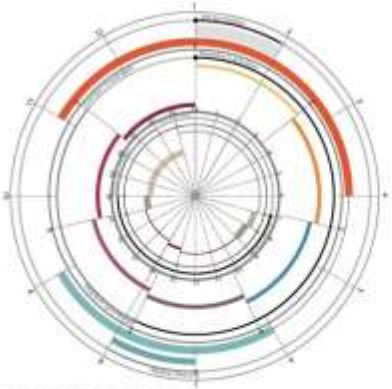
Dashboard can create opportunities for the public and experts alike to test options, such as individual building and roof potential for Solar PV applied to Provincial funding

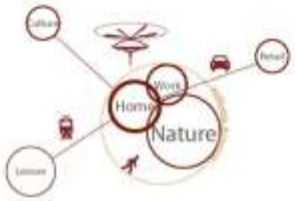
DASHBOARDS and WEB APPLICATIONS

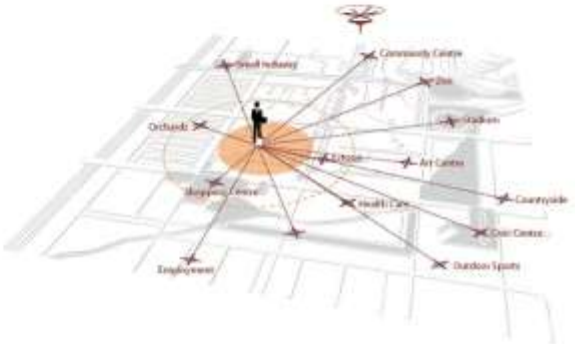
Flex or HTML5

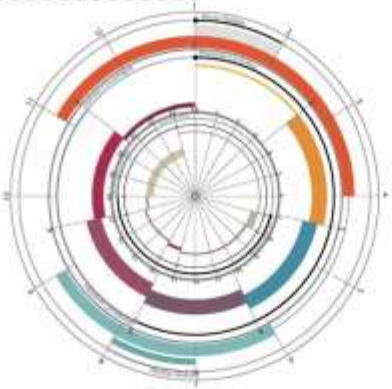
Example: FLEX web based Solar and Thermal Calculator, Feick, Uof Waterloo

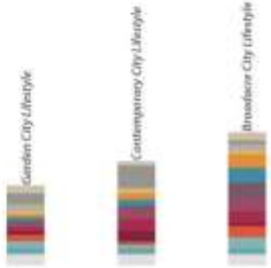


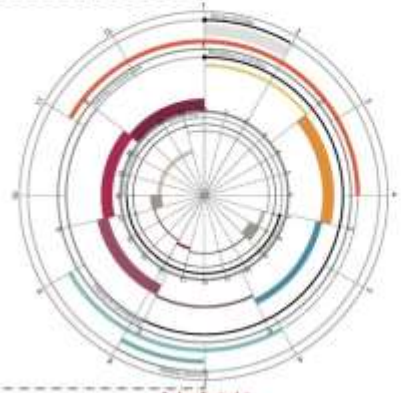












Spatial Concept *Urban Form & Lifestyle Choices* *Carbon Footprint*

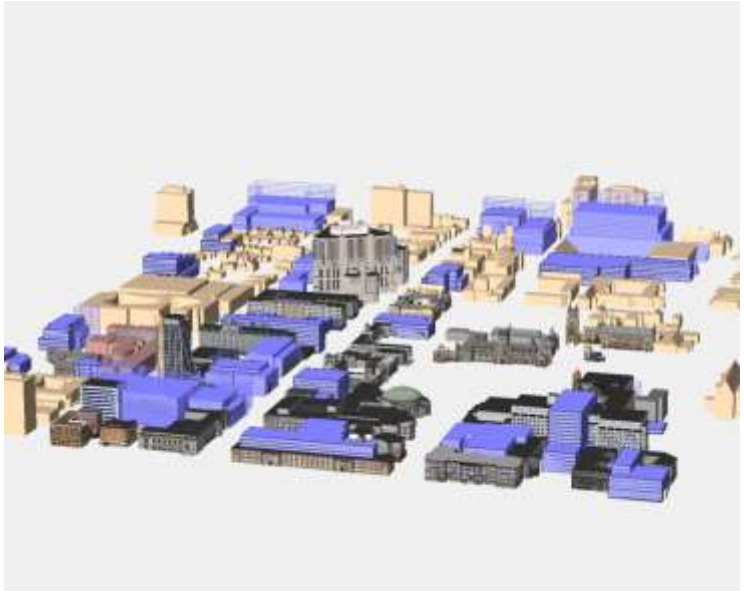
Wei Pang MLA Thesis – examining daily lifestyle requirements

Decision Support Techniques

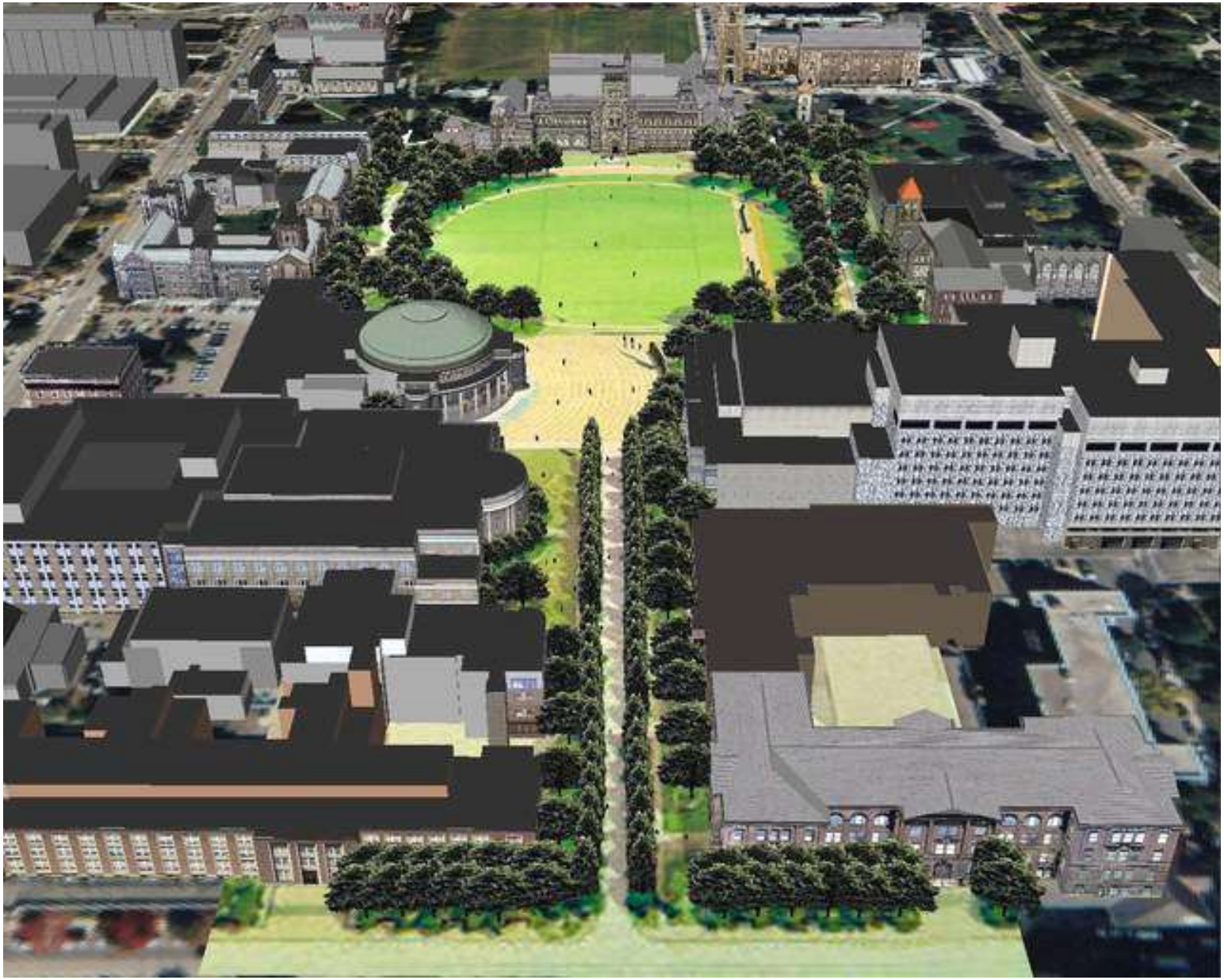
To address these problems, we will investigate and integrate techniques from four existing approaches to community decision-making:

- **Decision theatre** makes use of immersive visualizations, in which a group of people engaged in complex decision processes can be brought together in a specially designed theatre that provides large format immersive visualizations of the 3D built environment and of 3D views of abstract data spaces.

- **Participatory Design** provides a methodology to explore design choices and understand needs. These have traditionally been used for user interface design and workflow systems, The challenge here is to enhance PD methods with ways of exploring complex datasets that complement the participants' own experiences.



CLR – 3D negotiation models - University of Toronto



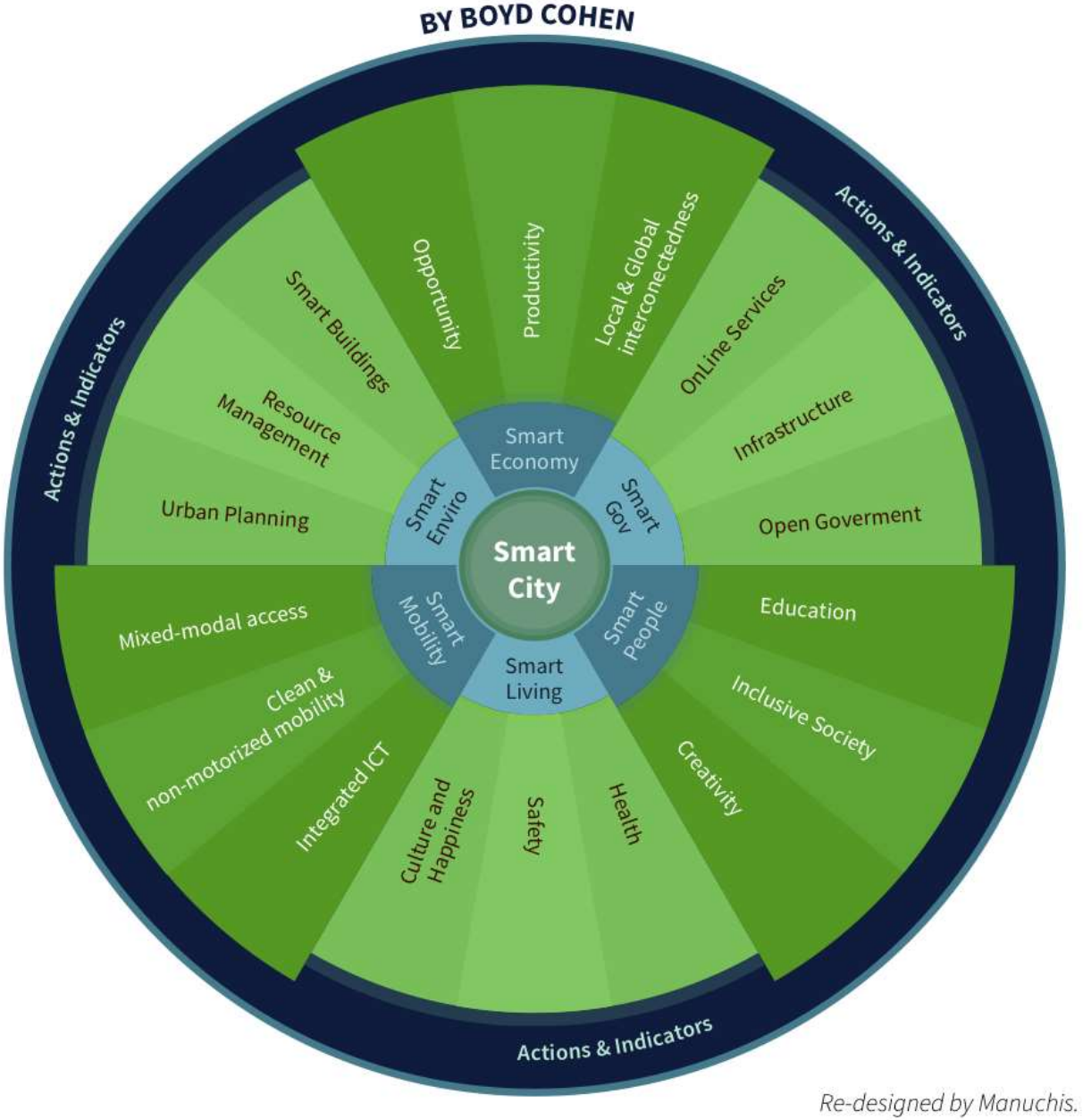
CLR – 3D negotiation models - University of Toronto

CLR – participatory negotiation models – complete streets – Lakeshore Road Community symposium

CLR – 3D City Models that “Show Me” the integration of smart cities thinking from metrics to human scale experience

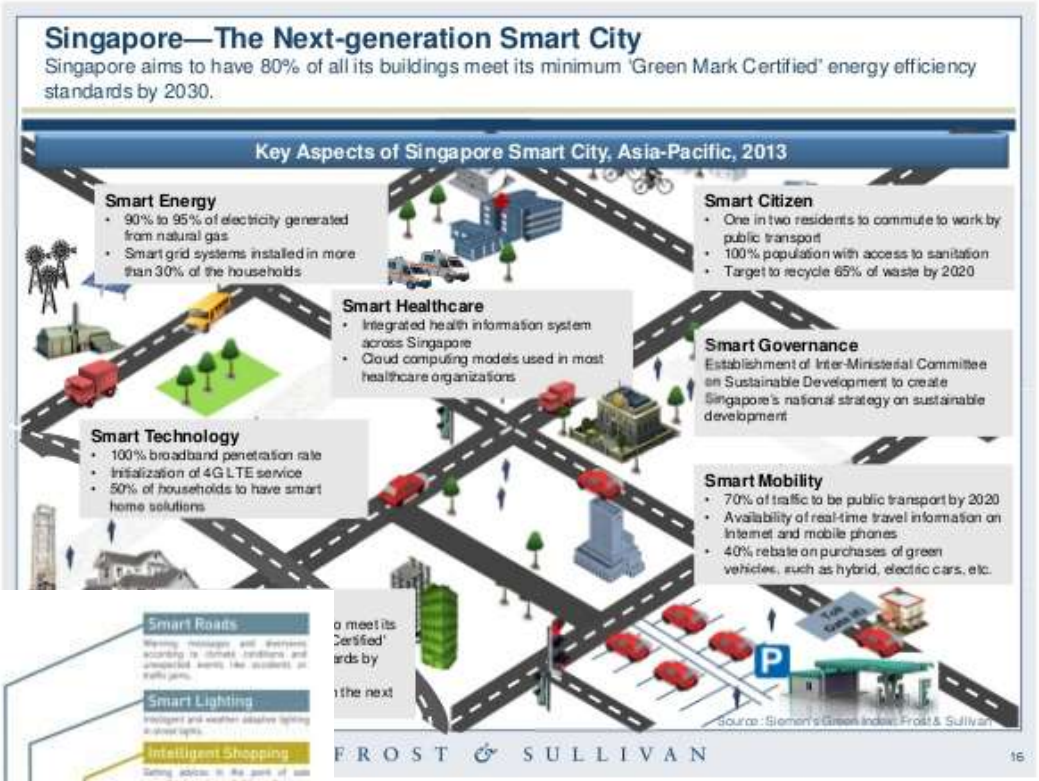
Decision Support Techniques

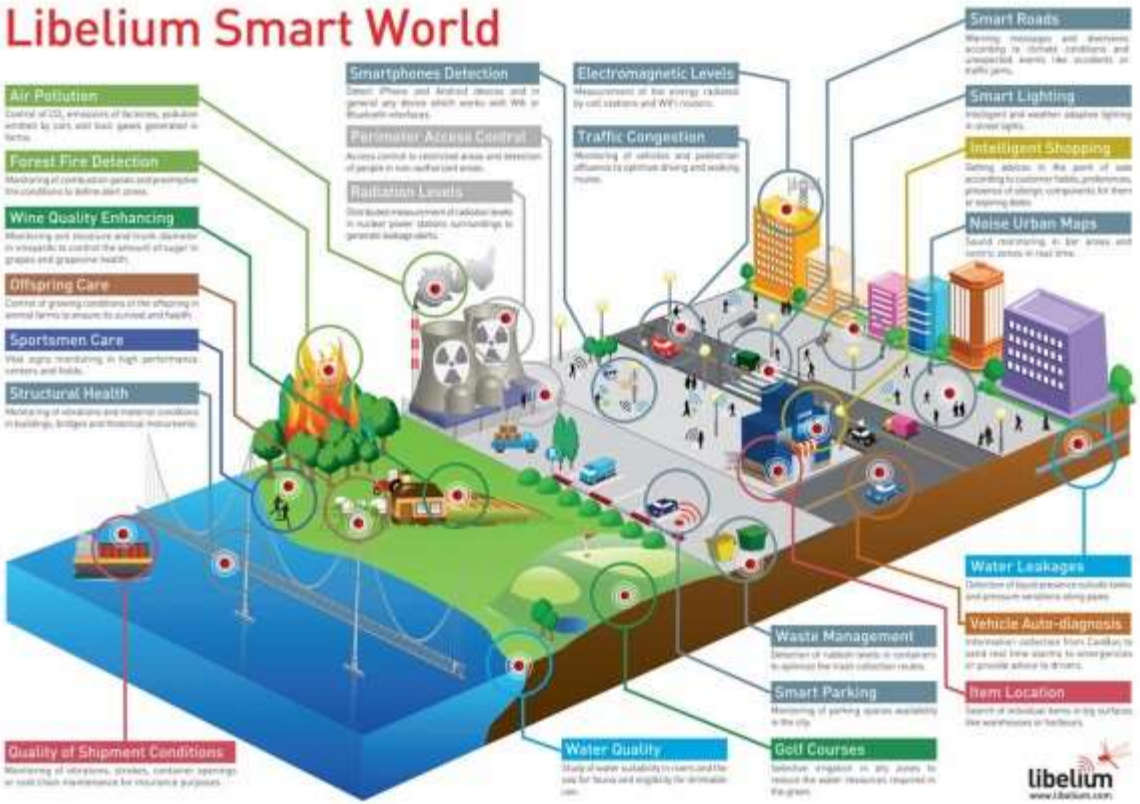
- **Online Communities**, The challenge in online communities is to find ways of building trust and assessing credibility and expertise of individual participants and information sources, when traditional social processes for recognizing credibility are absent. We will explore how to combine online community building with face-to-face techniques such as decision theatre and participatory design, to adapt to complex decision tasks requiring consensus-building and creative design solutions.
- **Crowdsourcing**, which bring together large numbers of people to create complex shared knowledge sources (e.g. Wikipedia, OpenStreetMap, etc) [c1]. These depend on simple protocols for editing a large shared knowledge-base, along with sophisticated social processes for maintaining overall editorial guidance to ensure the result is coherent. We plan to build on our existing prototype for an online shared carbon calculator, INFLO [c2] which acts as a visual wiki for quantitative analysis of complex decision problems, where participants can extend the analysis and link it to new data sources as they become relevant.



An example of the effort to holistically integrate human and technical factors in smart city thinking by Boyd Cohen. http://www.fastcoexist.com/3038818/the-smartest-cities-in-the-world-2015-methodology

He describes the current phase of smart cities thinking as one that incorporates citizen co-creation. http://www.fastcoexist.com/3047795/the-3-generations-of-smart-cities





There are many approaches to smart cities by various industries, municipal infrastructure departments and technical disciplines. Often these models appear very technical and leave out the dimensions of the livable smart city that are becoming a widely accepted requirement of a smart city. The next phase of smart city model research is to marry the technical models with human centric urban design models that capture lifestyle factors.

Smart Cities Research at University of Toronto

UofT President Gertler's priority on using the University's location in the Toronto Region as an asset and a responsibility

There is emerging evidence to suggest that such locational advantages are likely to become even more important to the success of educational institutions in the future. Indeed, Selingo (2014) documents an already marked and growing differentiation in the health and success of US universities and colleges along geographical lines: those that are located in major urban areas are, on the whole, outperforming those in more rural locations, and are substantially better positioned to prosper in the future.[6] He cites a recent study by Moody's Investor Services, which identifies a distinctly more challenging outlook for US institutions in rural and small-town locations, and a far brighter future for those located in large urban regions, for which demand is considerably stronger.

So our bench strength in urban-related research is considerable. Indeed, with something like 150 scholars distributed across more than 50 different academic units on three campuses, it is likely to represent one of the largest concentrations of such talent at a single institution anywhere in the world. And yet – and I say this as a long-time member of this community myself – it is fair to say that this is one of the best-kept secrets at the University. While the highly distributed, diffuse and decentralized set up can be a research strength, it also diminishes the visibility and profile of the University's urban scholarship as a whole. Many scholars in this broad area are well known internationally for their research and publications, we are all but invisible locally. And the collective scale, scope and impact of our research enterprise are consistently and systematically underestimated.

Bringing together the University Talent & Creating Research Catalogues

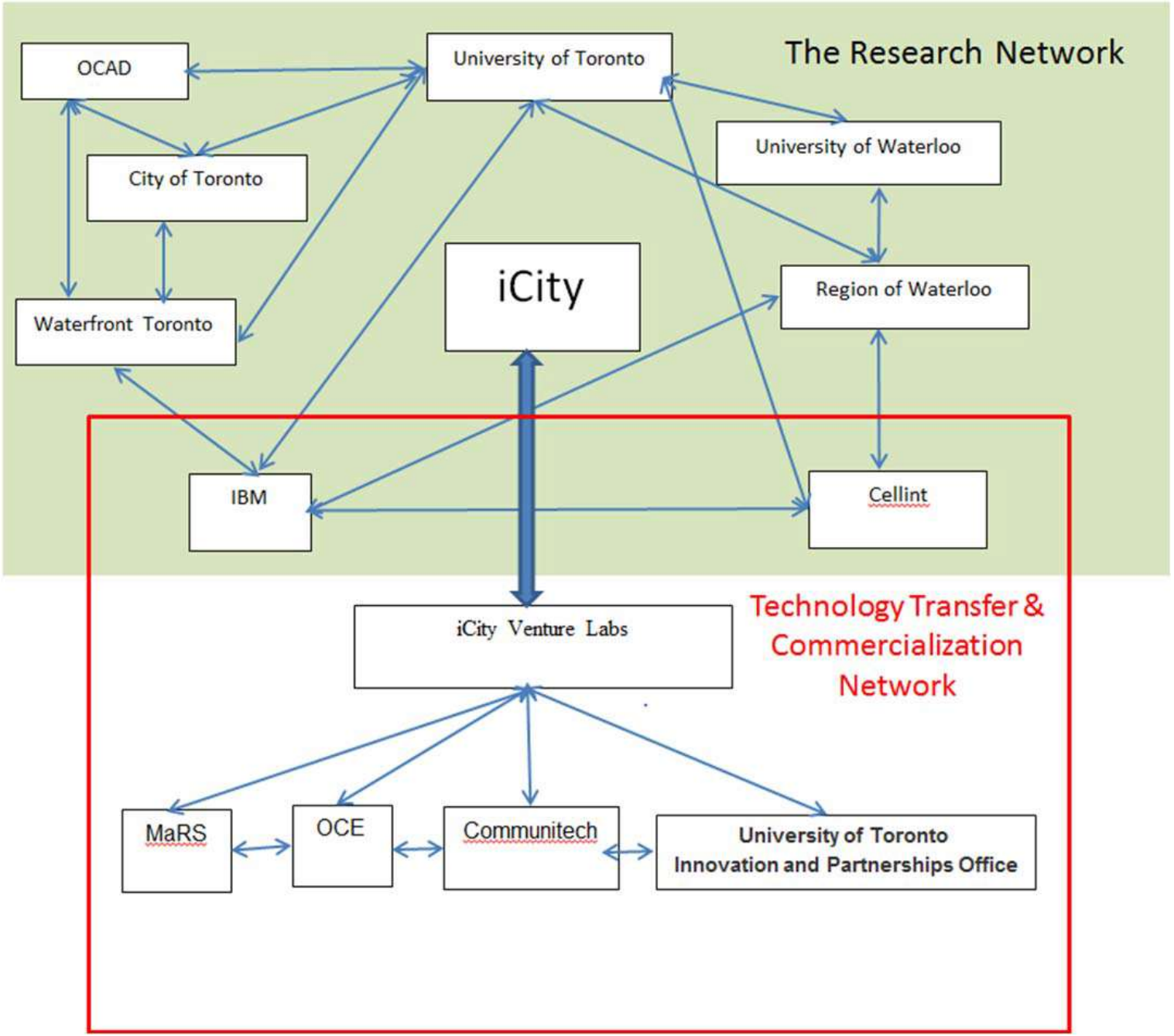
A second strategic action, complementing the first, focuses on enhancing the visibility of our urban scholarship by documenting and cataloguing the breadth and extent of our urban research activity across all three campuses. The template for this already exists in the form of research catalogues constructed around key interdisciplinary themes by the Office of the Vice-President, Research & Innovation.[9] Such a catalogue would have a dual purpose. First, it would help external partners and the public at large to identify and learn more about our urban expertise. Second, given the highly distributed nature of our research

Summary Framework

Three Priorities

Strategic Priority: Leveraging Our Location(s)

Lead	President's Office, supported by Advisors to the President on Urban Engagement and Urban Issues
Description	Taking better advantage of our location in one of the world's most vibrant, culturally diverse and economically dynamic regions, for the benefit of both the University and the residents of the Greater Toronto Area
Goals	• To improve the state of our host city-region • To enhance the University's success in attracting and retaining talented faculty, staff and students • To promote further success in research, teaching and learning by focusing on urban processes, dynamics and challenges such as poverty, housing, public health, innovation clusters, environmental and energy systems, transportation, political systems, design, planning, and more • To enhance the University's standing and reputation as a city-building institution
Key Elements	• Urban research • Urban teaching • Local outreach and partnerships • Strengthening the built environment
Milestones & Deliverables	• Appoint Presidential advisors on urban engagement and urban issues • Catalogue urban research, teaching, outreach activities • Convene faculty members with urban interests to consider ways to raise profile, enhance coherence of urban research, teaching, outreach • Collaborate with Provost's Office and Centre for Community Partnerships to expand opportunities for experiential learning in local communities


The Research Network
OCAD
University of Toronto
University of Waterloo
City of Toronto
iCity
Region of Waterloo
Waterfront Toronto
IBM
Cellint
Technology Transfer & Commercialization Network
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Global Cities Institute

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Model Cities Theatre and Lab

@ 1 Spadina Crescent

The new Model Cities Theatre and Lab will draw on comparative data and insights from the GCIF for use in conjunction with emerging 3D and other visualization techniques in order to test and project new ideas in urban design. The theatre and lab will facilitate research on designing cities holistically, and offer a public forum for creating new decision frameworks, design options, policy alternatives, and industry solutions.