

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

RESOURCES

Computing

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- Global Cities Institute
- Green Roof Innovation Testing Laboratory (GRIT Lab)
- Responsive Architecture at Daniels (RAD Lab)
- Centre for Landscape Research
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- Model Workshop
- Writing Centre
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Research Laboratories



The CLI has two research laboratories (Immersive visualization and the Green Roof Innovation Testing - GRIT - Lab) in which several faculty collaborate. The digital media project has been running since the early 2000's and tackles unique projects and research questions that look into ways of adapting the disciplinary language and methods of landscape architecture through spatial computing and design-planning practices. The laboratory has specialized in projective urban modeling and visualization. The Immersive visualization room established in partnership with Parallel World Labs (a Toronto based company established by alumni of CLI) is used as a prototype urban design decision theatre.

The second research facility in CLI is the Green Roof Innovation Testing (GRIT) Lab. The GRIT is dedicated to the study of Green Roofs, Green Facades and Solar Technologies and is led by Professor Lisa Margolis.



Global Cities Institute

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A Dialogue on Smart Cities in India

As the Government of India unveils its Smart Cities Initiative, there are many promising opportunities for collaboration between Canadian stakeholders and Indian cities. In June 2015, the Global Cities Institute organized a Smart Cities in India Roundtable to discuss these opportunities with stakeholders. The roundtable is a prelude to a GCI city mission to India to engage with partners in fall 2015 and a second roundtable discussion to strengthen the Institute's partnerships with the Prime Minister Modi's Smart Cities Initiative.

[Read more about the GCI and India's Smart Cities initiative](#)

1 SPADINA

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GREEN ROOF INNOVATION TESTING LAB (GRIT)

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knowledge media design institute
 UNIVERSITY OF TORONTO
 FACULTY OF INFORMATION
 Knowledge Media Design Institute

Collaborate

Welcome. We are a human-centred collaborative design institute at the University of Toronto.

Learn

KMDI has been involved in graduate teaching since 2002. Check out our Educational Programs and Offerings!

Engage

Join our blog and news feed and start a conversation.

The **Knowledge Media Design Institute (KMDI)** is an interdisciplinary unit of the Faculty of Information at the University of Toronto. Founded in 1996 by Professor Ron Baecker, the institute is U of T's first virtual institute to deal with interdisciplinary issues of collaborative design in the artifacts of knowledge creation, production and distribution. Representing over 25 units across three campuses of the university, KMDI was launched in 1997.

In 2002, the Institute became involved in teaching with the introduction of a Collaborative Program in Knowledge Media Design. The Collaborative Program in Knowledge Media Design offers an interdisciplinary specialization to a regular departmental degree program.

Today, our researchers and students explore, design, and critique the knowledge media that enable people to communicate, create, learn, share, and collaborate. The institute has a cluster of offices in the **Robarts Library** as well as a meeting room and classroom. The current director, Professor Mark Chignell, along with a distinguished



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



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.

University of Toronto, Faculty of Applied Science & Engineering

The Centre for Resilience of Critical Infrastructure

Home About Education Research Sandford Fleming Forum



Blast Loading

Read more about the latest field blast trial conducted as part of the Explosive research program into protection against the effects of energetic loadings.

Infrastructure in the News

Why did Canada's GDP and Energy Use Diverge after 1995?

Facilitating power by Torris et al.

Before the Next One

The inter-connected nature of urban resilience planning and what this means to asset management

Availability of Infrastructure: Resilient Cities

About CRCI

The Centre for Resilience of Critical Infrastructure (CRCI) is an initiative of the University of Toronto's Faculty of Applied Science & Engineering to advance the field of infrastructure engineering and the understanding and practice of infrastructure resilience. The CRCI builds upon the University's existing world-class reputation in engineering and the built environment, bringing together expertise in research and practice from around the world, across government, academia and industry.

The CRCI structure and philosophy is based upon the government's identified vision for future Canadian capability. The Centre was established due to the government concern that there exists a lack of competent skills and practices of resilience planning in Canada and a lack of professional understanding of the requirements. The CRCI was established to identify competencies amongst stakeholders, while the Sandford Fleming Forum seeks to address the issue of understanding by engaging directly with the professional community of governments, clients, consultants and academia to promote discussion on current and emerging threats and concepts.

Professor Christopher Kennedy

Environmental Engineering Research Group



Contact me

Christopher Kennedy
Dept. of Civil Engineering
University of Toronto
35 St. George St.

Research Interests

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

Map and Data Library, UofT

maps.library.utoronto.ca/cgi-bin/search.pl

Google DuckDuckGo Bookmark Manager Imported From Fire... Facebook Welcome! LinkedIn CityEngine 2015.2 re... Other bookmarks

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Home

Search the Geospatial (GIS) Data & Map Inventory

in **All Maps and Geospatial Data**

Other Search Options: [Custom Search](#) | [Advanced Search](#) | [Scholars Portal Geospatial Portal](#)

About this search tool

All geospatial datasets available at the University of Toronto, and some held elsewhere, are searchable using this tool. Other items that are searchable include our collection of **scanned maps (out of copyright)**, **open data** created at the University of Toronto, as well as some of our **paper maps** that have yet to be scanned because they remain under copyright restrictions. Please note that our paper map collection is searchable via the regular library catalogue at onsearch.library.utoronto.ca.

Search filters can be used to limit your searches to these distinct areas of the Geospatial Data & Map Inventory, including datasets only available to University of Toronto, Open Data created at the U of T; searching only down

UofT Digital Map Library

geo2.scholarportal.info/utoronto/

Scholar's GeoPortal

Search

☐ Data ☐ Place or address

Browse by...

Subject category

- Census and administrative boundaries (12)
- Geological and geographical (2)
- Internal water resources (4)
- Environment and conservation (2)
- Business and economic (1)
- Imagery, base maps, and land cover (1)
- Locations and geographic networks (1)
- Culture, society, and demographics (1)

Keywords

Producers

More Maps...

2015-12-09-09-09-09.jpg

If you are off-campus, please login

Map of Ontario showing major cities and Lake Ontario.

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

Fast and affordable tools can enable Real Time Visualization and Projective Modeling that allows people to see for themselves



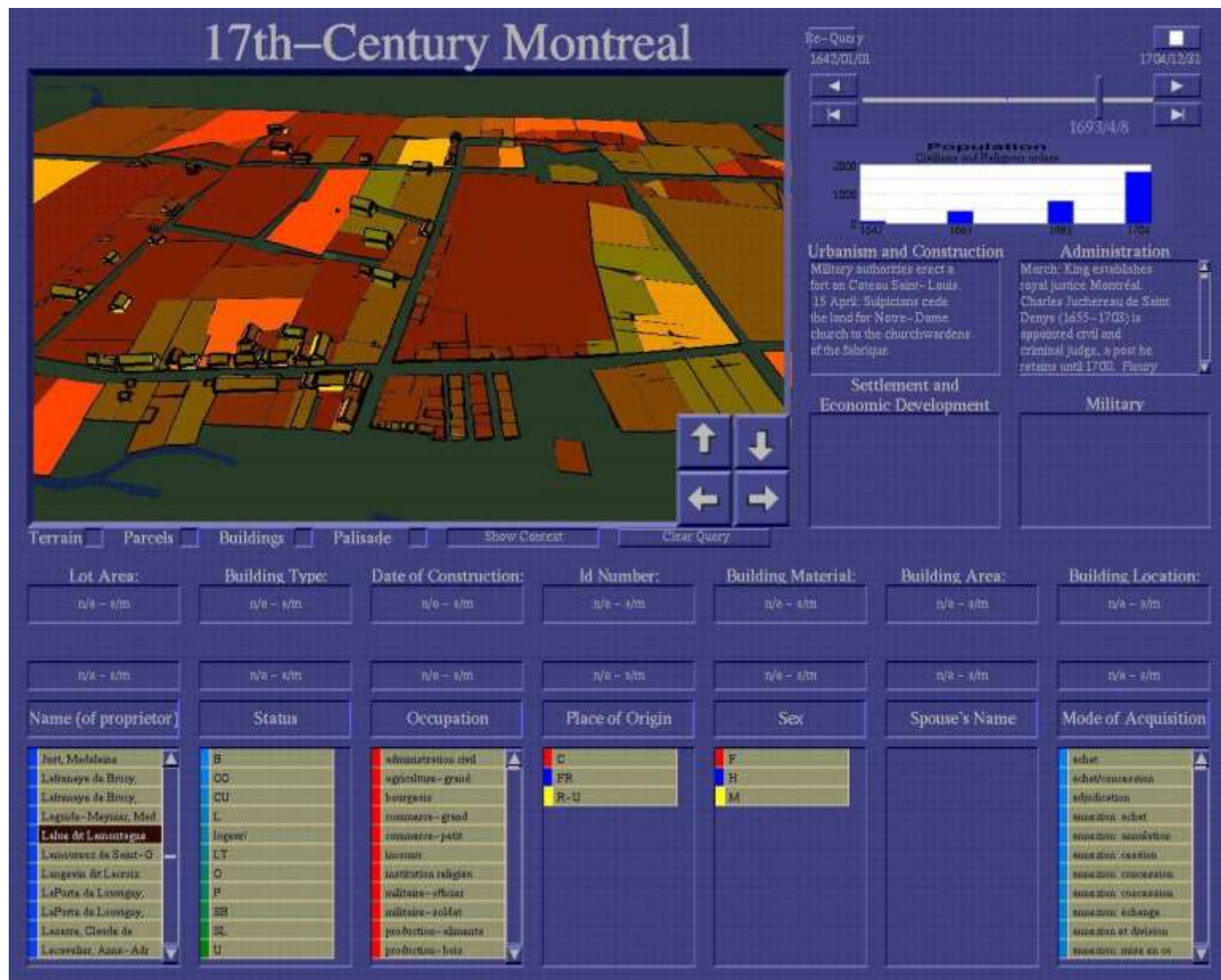
Montréal au XVIIe siècle

Marche - 1
Place D'Armes
Place J Cartier
Place J Cartier2
Aerial - 1
3D/2D
Parcel Outline
Terrain
Parcellaire
Bâtiments
Palissades
Nouvelle recherche
unlead new
Occupation
Land Use
Muskets (1805)
Cannons (1805)

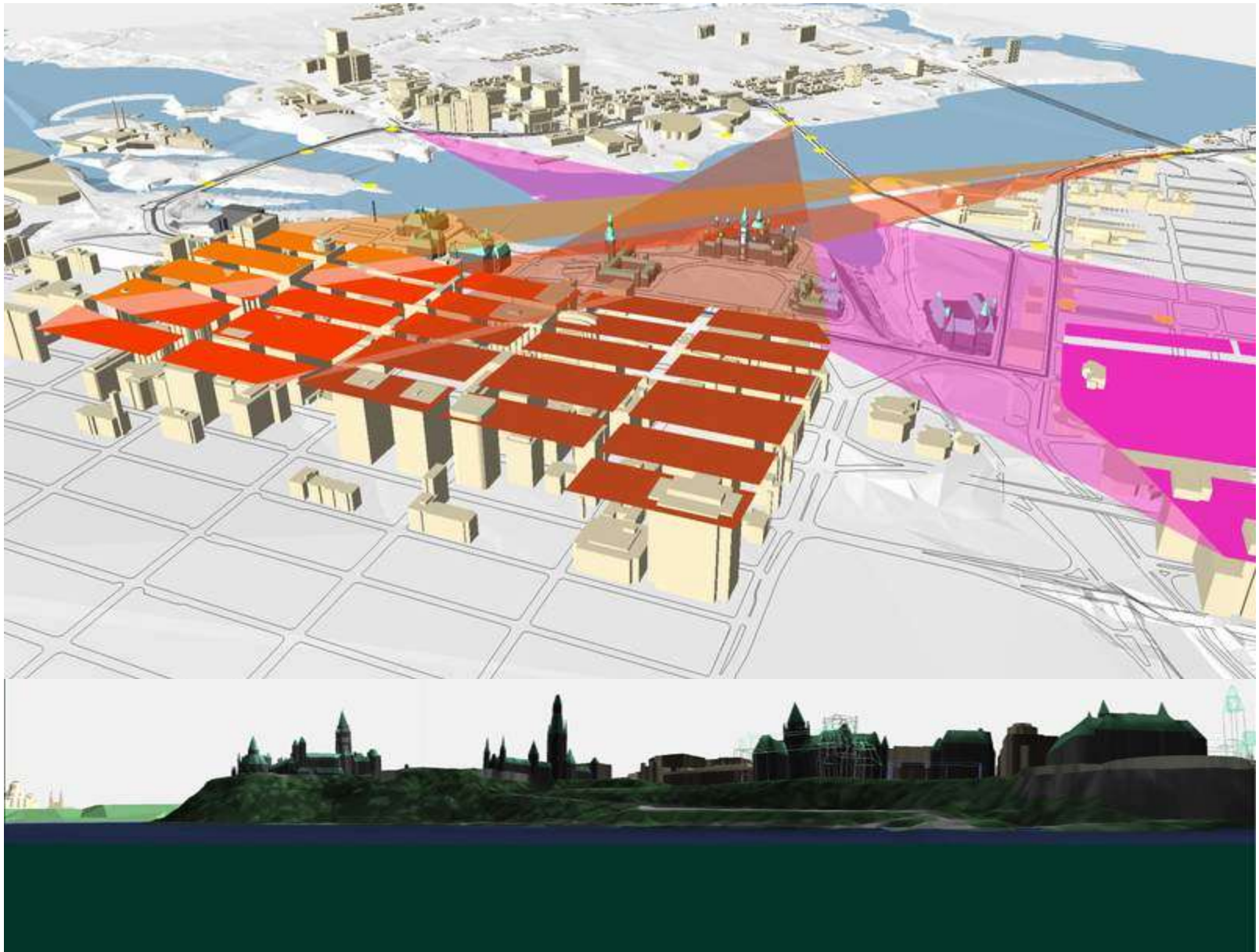
1705 1725 1745 1765 1785 1805 1829

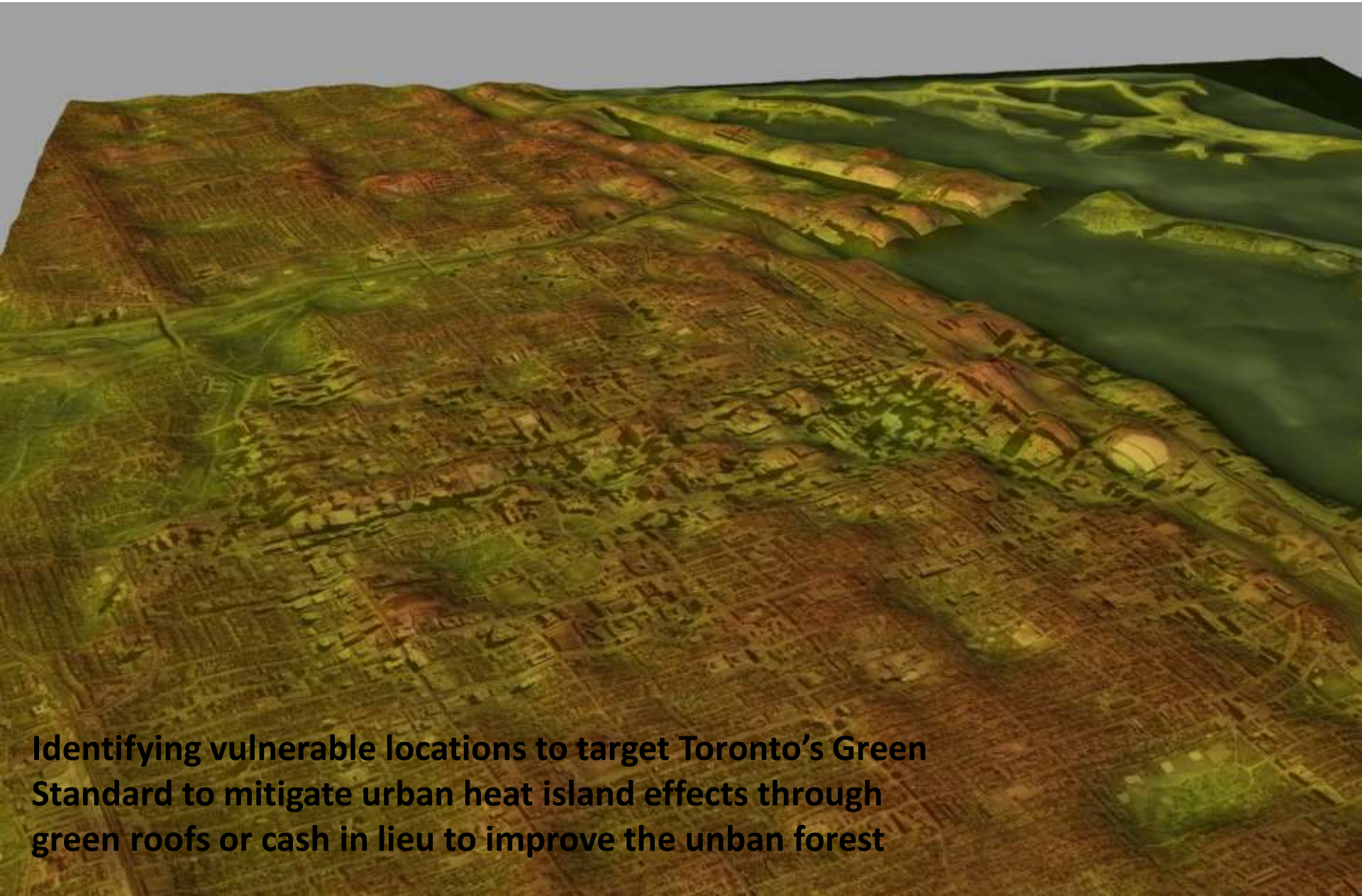
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Fields

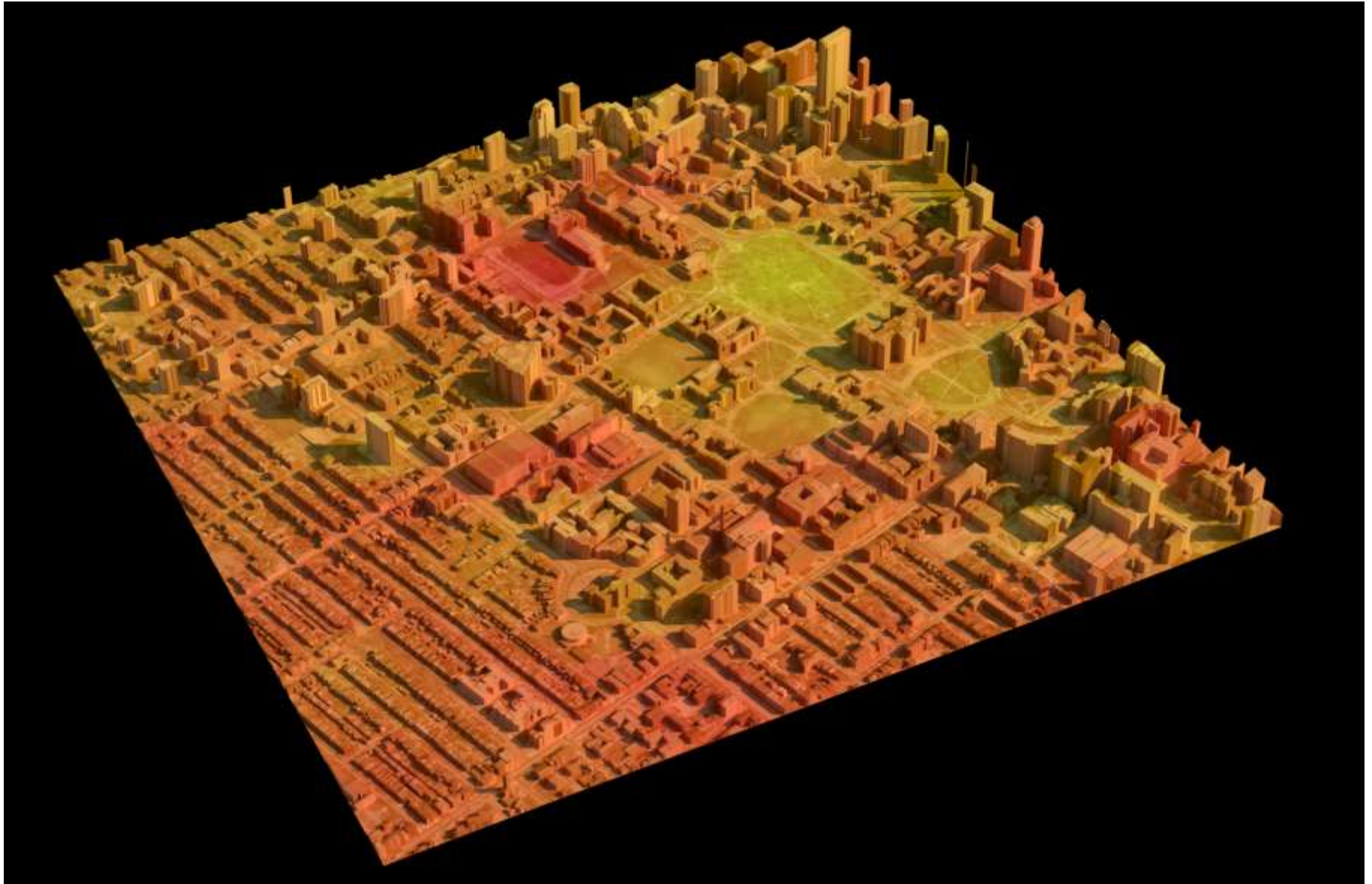


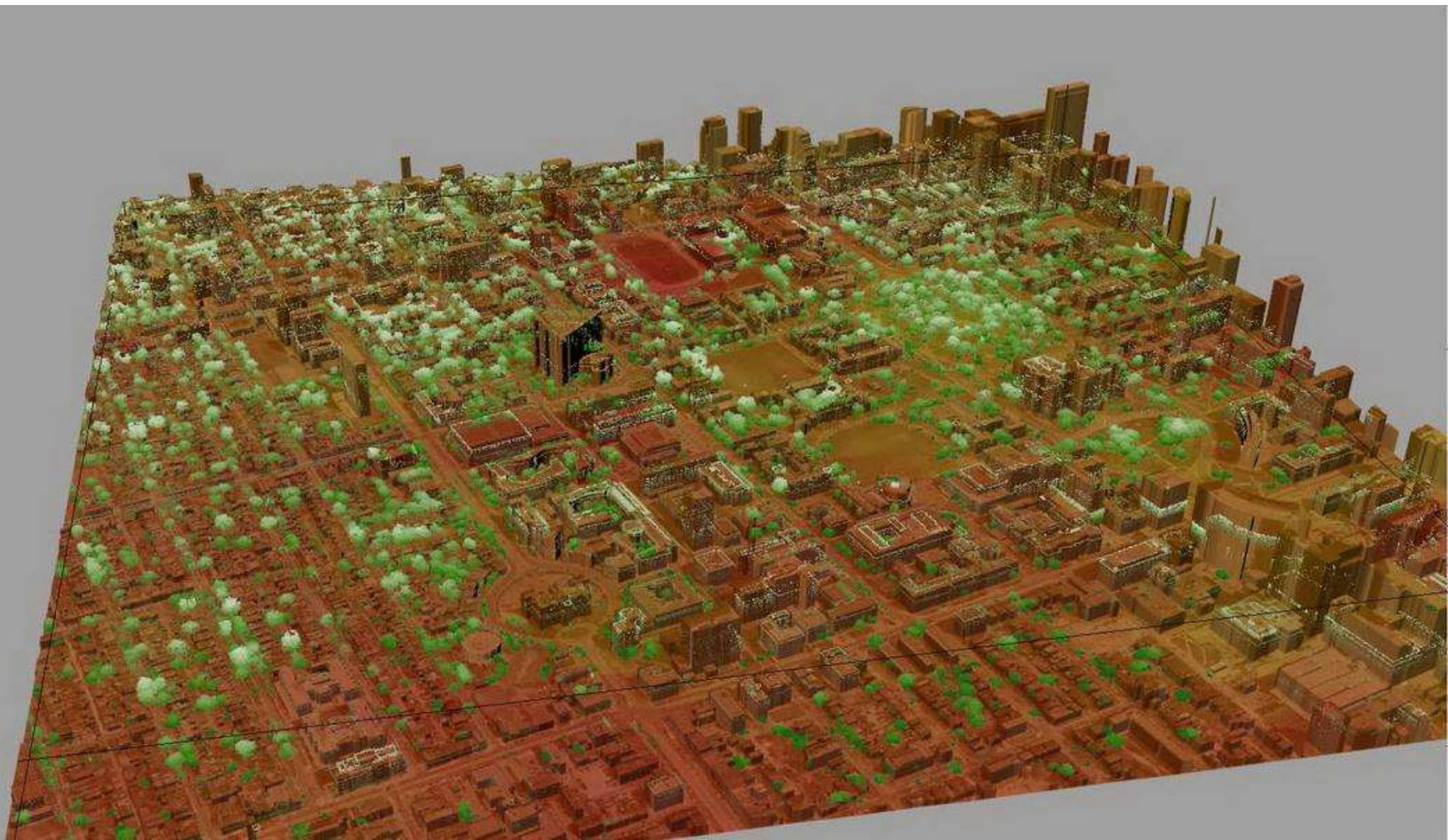
Ottawa National Capital Views Real-time Evaluation and Change Model



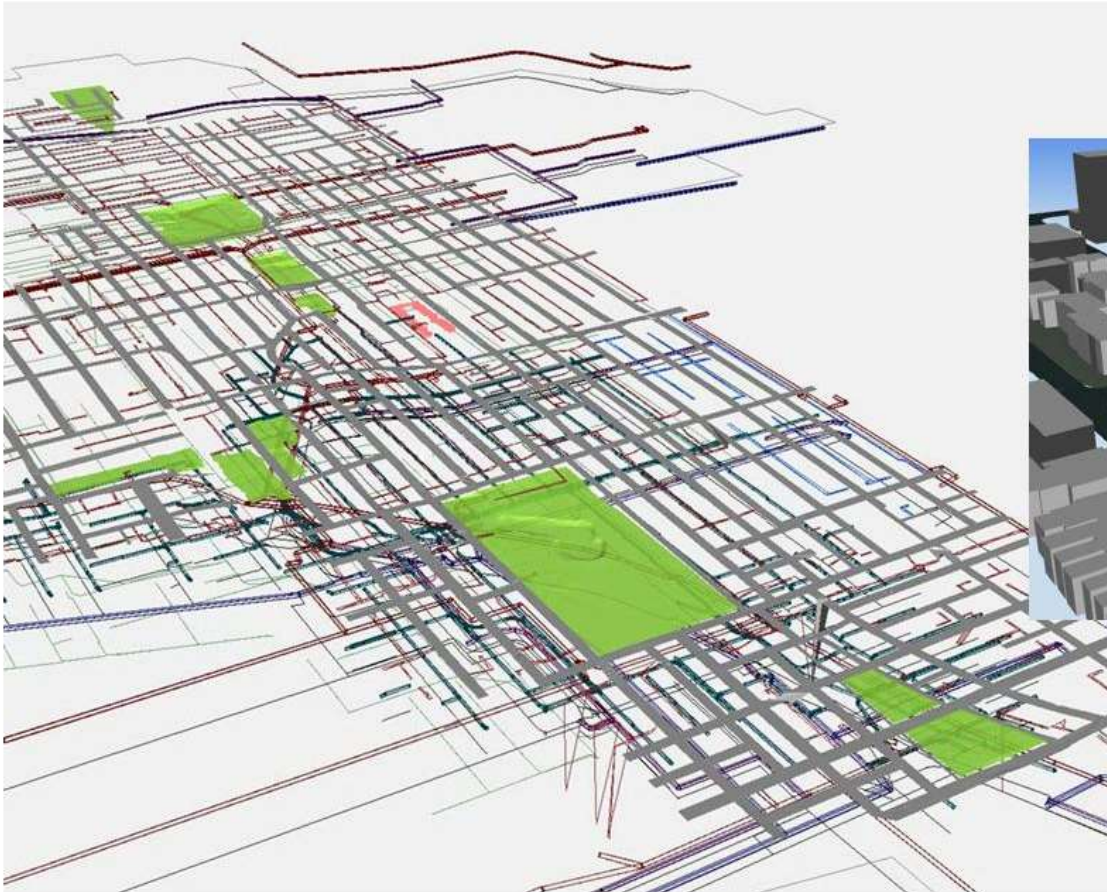


Combining Remote sensed temperature with 3D built form to study urban heat island issues
CLR GEOIDE NCE





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

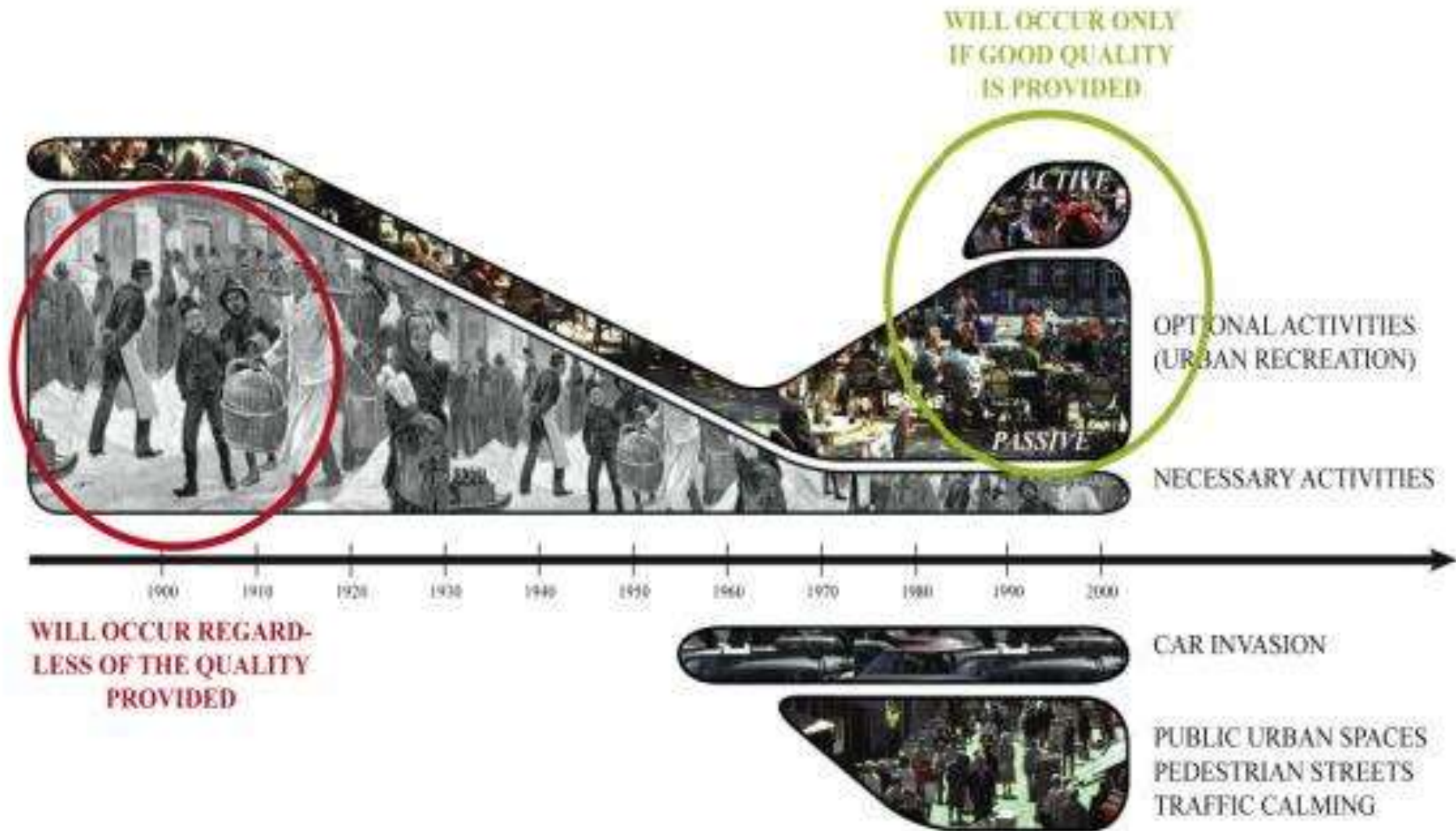


Today, many people have discovered positive aspects of urban living



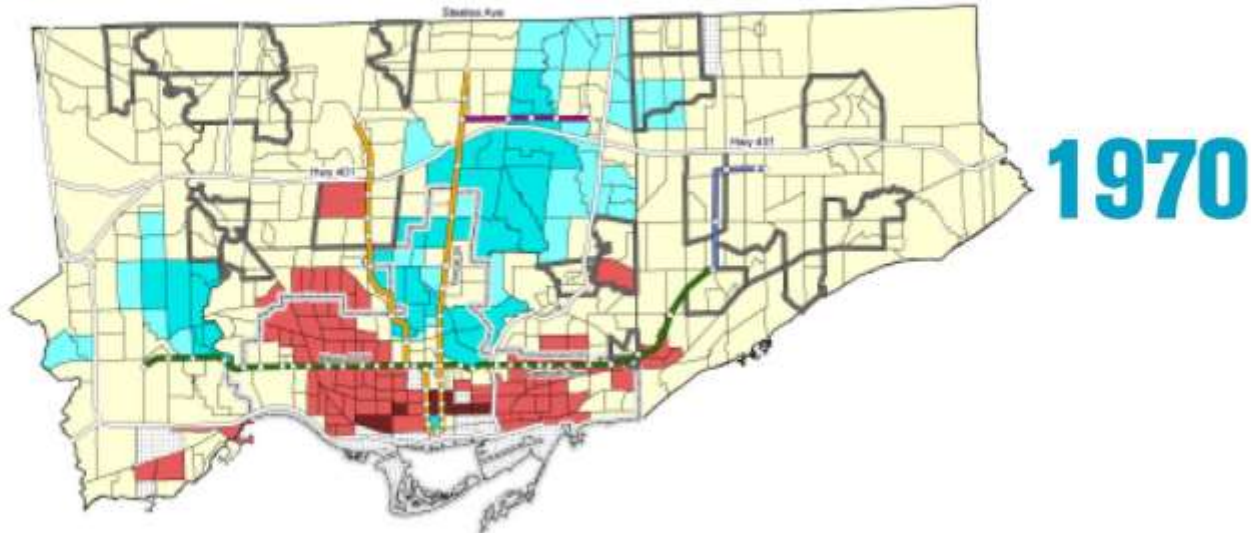
and a reverse migration is fostering lifestyles that minimize the need for a car.





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

More than 40% Above
36 Tracts, 7% of City
Average = \$54,700*

High

20% to 40% Above
41 Tracts, 8% of City
Average = \$39,000*

Middle Income

20% Below to 20% Above
341 Tracts, 66% of City
Average = \$29,800*

Low

20% to 40% Below
91 Tracts, 18% of City
Average = \$22,300*

Very Low

More than 40% Below
6 Tracts, 1% of City
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

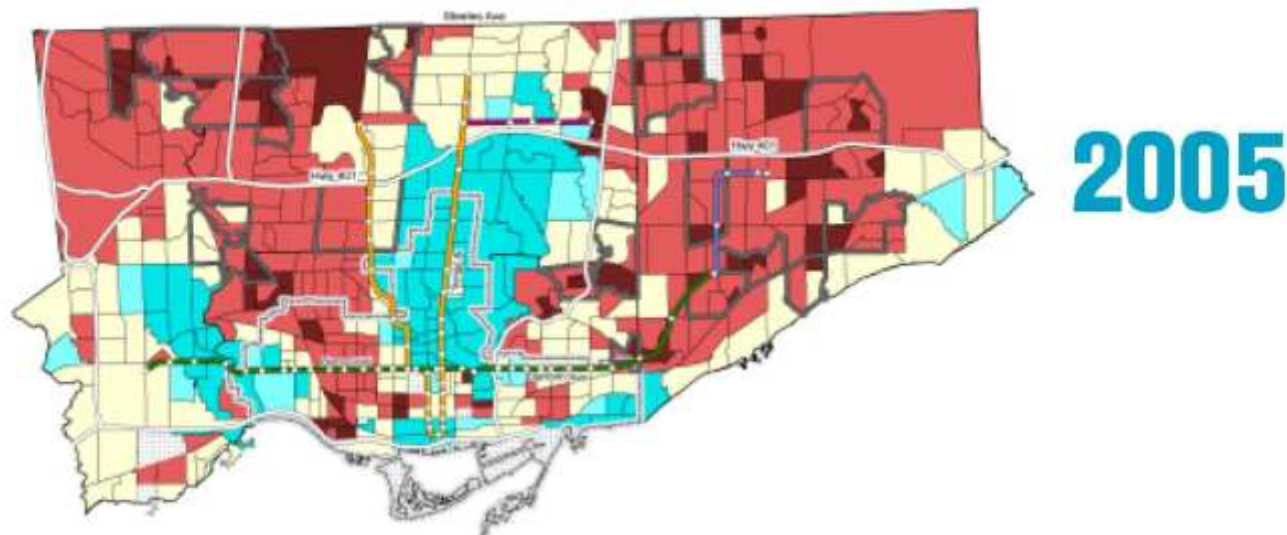
a census tract is generally 2,500 to 8,000. The City of Toronto encompasses 531 census tracts (as of the 2006 Census). Each has an average population of about 4,700 people. "Census tract" is used here interchangeably with the term "neighbourhood."

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.

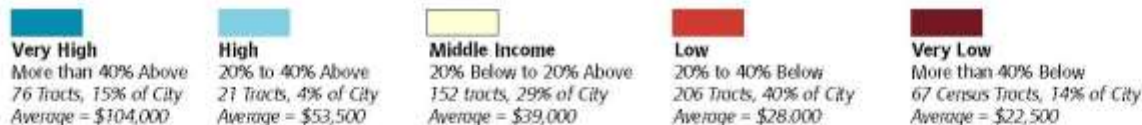
However, gentrification and cost have supplanted the original high quality immigrant staging neighbourhoods that are inherently walkable and have the highest possibilities for urbanity.



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



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



NEIGHBOURHOOD POLARIZATION SINCE 1970: THREE DISTINCT CITIES EMERGE WITHIN TORONTO

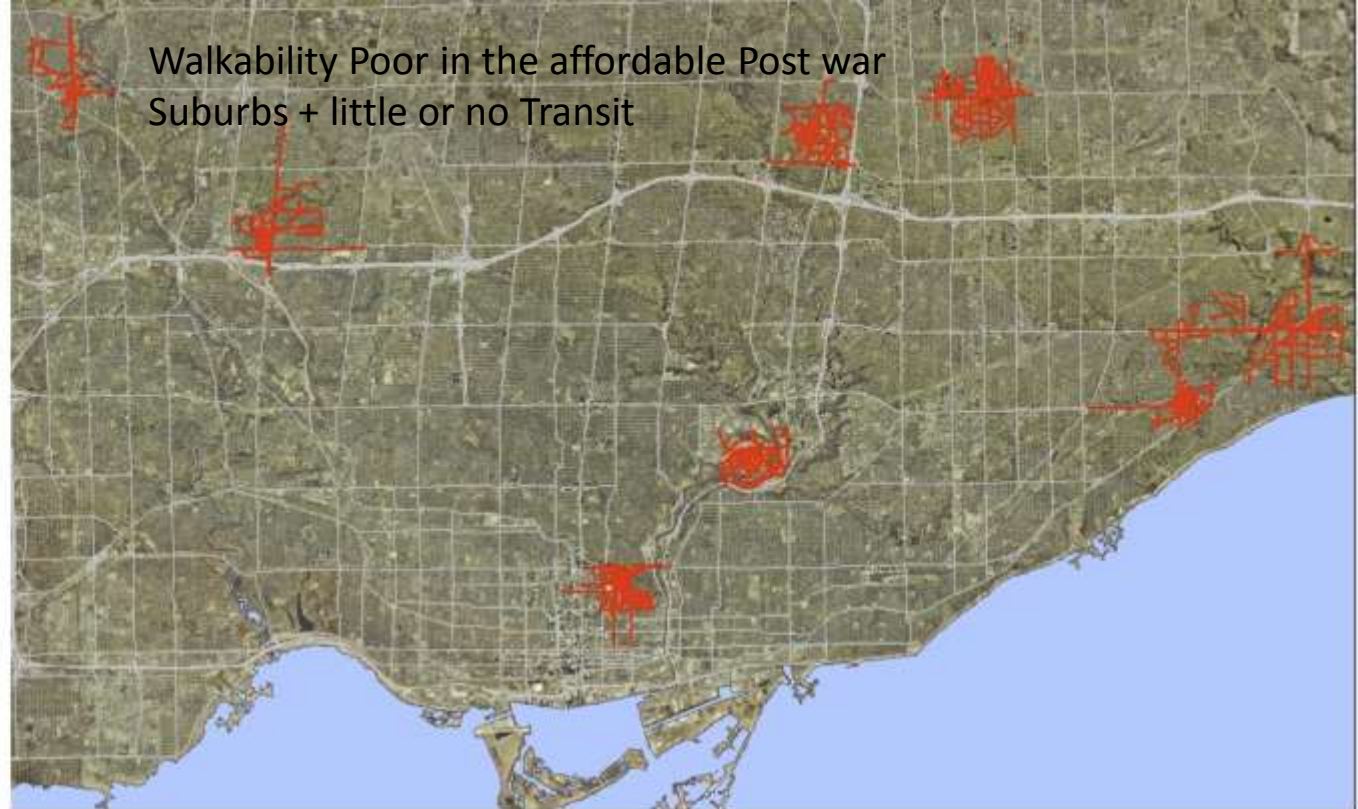
The City of Toronto is huge: 632 square kilometres (244 square miles). With more than 2.5 million people living in its residential areas, a 20% increase since the early 1970s, the nature of its neighbourhoods has changed over time to reflect significant changes in the demographic characteristics and 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



Walkability Poor in the affordable Post war
Suburbs + little or no Transit

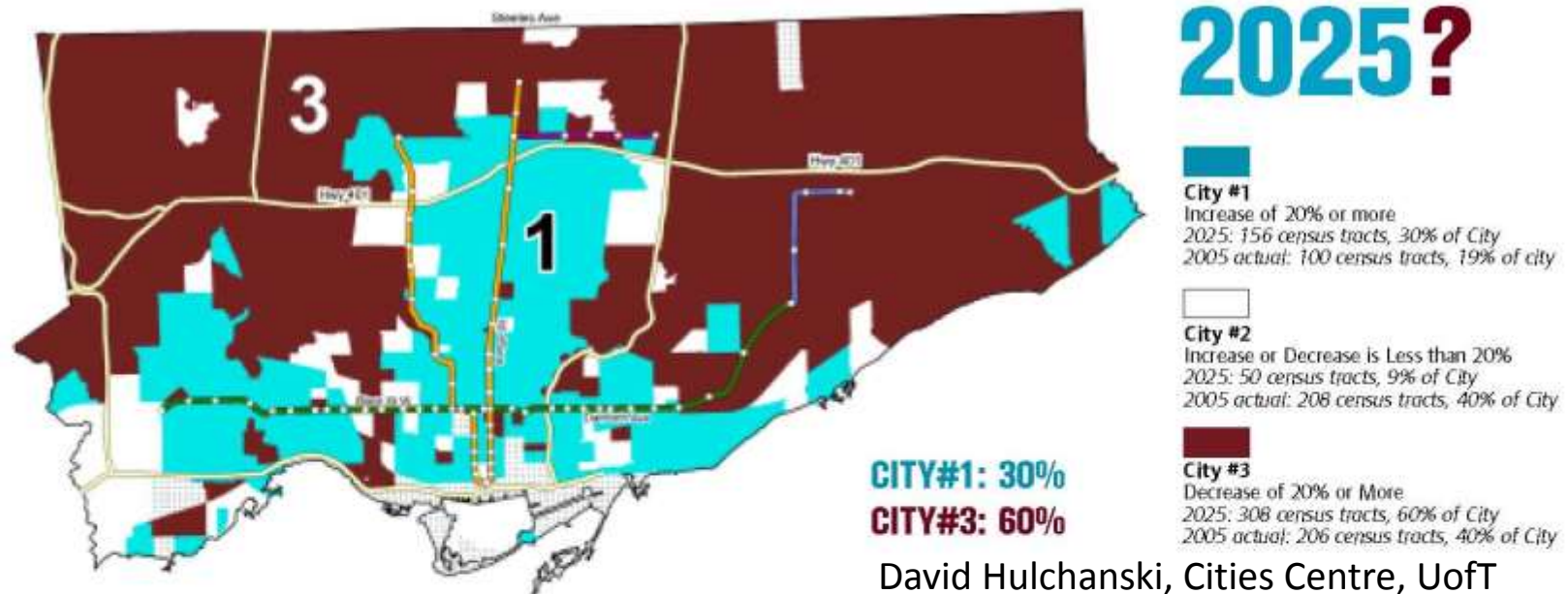
Paul Hess, Cities Centre, UofT



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



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 become increasingly desirable areas of the city, attracting higher

“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.

at CLR we have been exploring
the possibilities, inventing
software & testing in
real world practice



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:



Lakeview Legacy process:



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)

An aerial photograph of a city, likely in Canada, showing a dense grid of streets and highways. The city is surrounded by green fields and some water bodies. The text "Issue: How to retrofit the automobile scaled post WWII Canadian Cities as Smart Sustainable Cities?" is overlaid in the center. The Google logo is visible in the bottom right corner.

Issue: How to retrofit the automobile scaled post WWII Canadian Cities as Smart Sustainable Cities?

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Imagery © 2011

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: 1,141ha
 Population: 12,000
 Density: 10,518 ppl/ha
 Dwelling Units: 6,250
 Average Household Size: 2 people / household
 Parking: 1.2 / unit
 Business: 307,800 person
 Employment: 2,000
 Tree Canopy: 20 %
 Travel Time to Transit Stop: <= 3 min



Total Area: 100 hectares
 Population: 12,000 - 15,000
 Population Density: 120 - 150 persons/hectare
 Dwelling Density: 120 - 150 dwelling units/hectare
 Parking: 1.2 spaces/dwelling unit
 Tree Canopy: 11.3%
 Permeable Impervious: 70.2%/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 Fills),
 Shoppers Drug Mart, bank,
 eat-in, fast casual, cafe, bar,
 restaurant
 jobs: 1500-1800



Travel Time to Transit Stop: 3 minutes
 Travel Time to Mississauga City Centre: 35 minutes
 Travel Time to GO Station: 5 minutes to Long Branch
 15 minutes to Port Credit
 Travel Time to Toronto Downsview: 40 minutes
 Urban Ecology Tree Canopy: 08.2% land area
 Permeable/Impervious (73.3%/26.7%)
 Urban Density, Form, Program
 Total Population: 12,000
 Population Density: 120 persons/hectare
 Dwelling Density: 120 units/hectare
 Parking: 1.2 spaces/dwelling unit
 Demographics: Socioeconomics
 Pyramids (29% S+ < 30% 3-10% income share on
 Average Household Size: 2.3
 Urban Economics Retail Intensity: (25.3rd Business/1000 persons)
 Real Estate Values: \$3000/m²



Business Type Morphology: (order to land use)
 Jobs: 1,200 total employment
 Green Transport: on Travel Time to Transit Stop: 3-5min
 Travel Time to Mississauga City Centre: 20min
 Travel Time to GO Station: 10min
 Travel Time to Toronto Downsview: 30-40min



Tree Canopy: 25%
 Impervious / Permeable: 27% / 73%
 Expected Population: 12,000
 Population Density: 122 people / hectare
 Dwelling: 4780 units
 Building Typology: Apartment Building
 # of Businesses: 66
 jobs: 1100+
 Local Bus Routes and Holiday and Event Bus Routes



Residential: 654,191
 Commercial: 46,688
 Cultural & Entertainment: 26,733
 Office: 87,235
 Green Space: 621,088
 Institutions: 10,080
 Public Square: 47,776
 Parking: 1,200,000
 Aquatics: 100,000
 Industrial: 11,080

Population: 15,000
 Household Units: 6,000
 Vehicles: 6,000 (1 per household)
 Retail: 147
 Institutions: 1
 Library: 1
 Gallery: 1
 Community Center: 3
 District Energy: 1
 Supermarket: 1
 Sport Center: 1
 Shopping mall: 2



Total Area: 100 ha
 Population: 15,000 - 12,000
 Density: 150 - 120 ppl/ha
 Dwelling Density: 120 - 150 dwelling units/hectare
 Parking: 1.2 spaces/dwelling unit
 Tree Canopy: 11.3%
 Permeable Impervious: 70.2%/20.8%
 Average Household Size: 2.3-2.5
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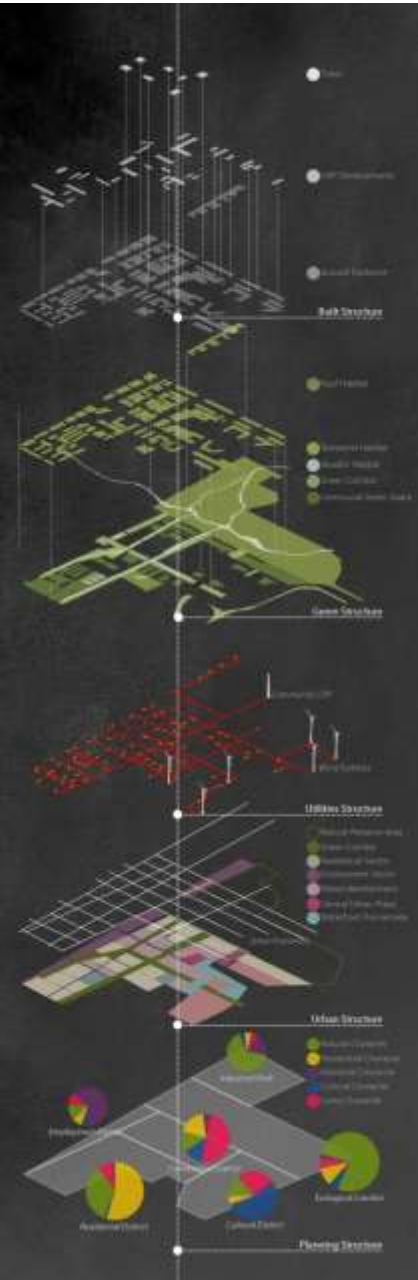
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 15 minutes to Port Credit



Total Area: 100 ha
 Population: 11,000
 Density: Units: 100
 Dwelling Density: 50/ha
 Business: 6000 employment
 Parking: 22,000
 Retail Units: 1,688
 Office: 68
 Tree Canopy: 14.7%
 Employment: 1,800 - 2,200
 Tree Canopy: 18%
 Travel Time to Transit Stop: <= 3 min
 Jobs: 12,000

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



Carbon-neutral Lifestyle: mapping a day in the Lakeview Life

This project intends to represent a day in the life of people who live/work/study in Lakeview and its surrounding neighbourhoods, and demonstrate how everyday choices at various scales (individual, community, city, and regional) can contribute to a more sustainable future. The activities are mapped across the day, showing how they are connected to the physical environment, the built environment, and the social environment. The activities are mapped across the day, showing how they are connected to the physical environment, the built environment, and the social environment. The activities are mapped across the day, showing how they are connected to the physical environment, the built environment, and the social environment.



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



Wei Pang – MLA Thesis - Centre for Landscape Research, University of Toronto
strategies for examining sustainable urban hydrology and constructed wetlands for tertiary waste treatment



SERON CREEK CONTAMINATION SOURCES

Serson Creek's Watershed Management Strategies



Residential Area



Light Industrial & Commercial Area



Industrial 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

Water Quality Deterioration

Previous Coal Pile Site
Site Cleaning
Brownfield phytoremediation

Constructed Wetland System

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

Periodic Flooding

Creek Mouth Marsh Rehabilitation

Loss of Creek Mouth Marsh

First Flush: 25 mm Rainfall

Total Retention Area

125,000m²

Retention Area

25,000m²

10 yr storm 20 min

Retention Area

100,000m²

25 yr storm 20 min

Serson Creek Source

Foundation Drain Collection (FDC)
Stormwater Discharge
Stormwater Overflow
Wastewater Treatment

Creek Baseflow

40 l/s

Marsh



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



A map of the study area in the city of Istanbul. The map shows a central area highlighted in black, which is the study site. This central area is surrounded by a yellow-shaded region, which represents the residential area. The rest of the map is grey, representing the city area. A legend in the bottom right corner identifies these three categories: 'Study site' (black), 'Residential area' (yellow), and 'City area' (grey).

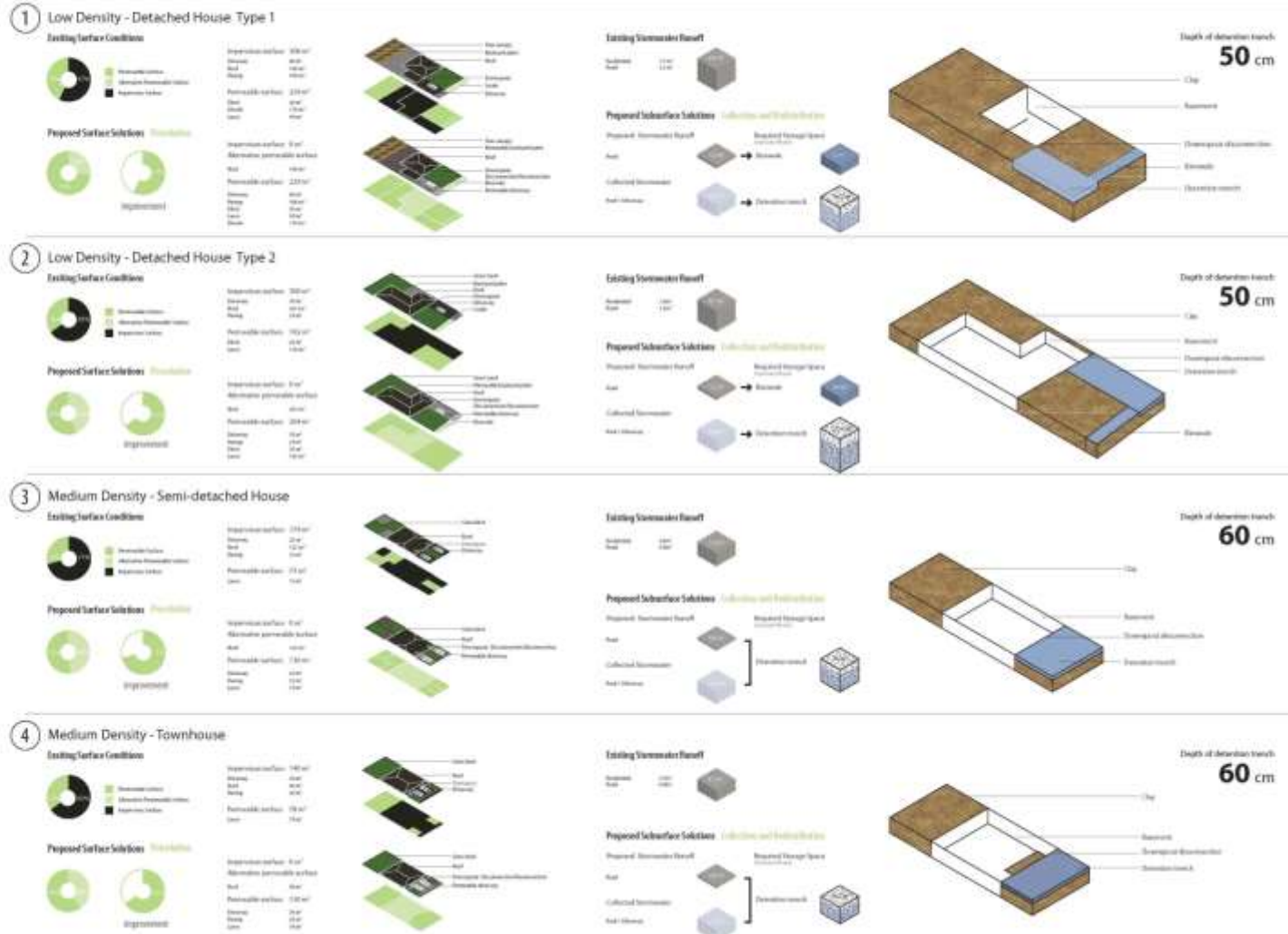
Reduce surface runoff

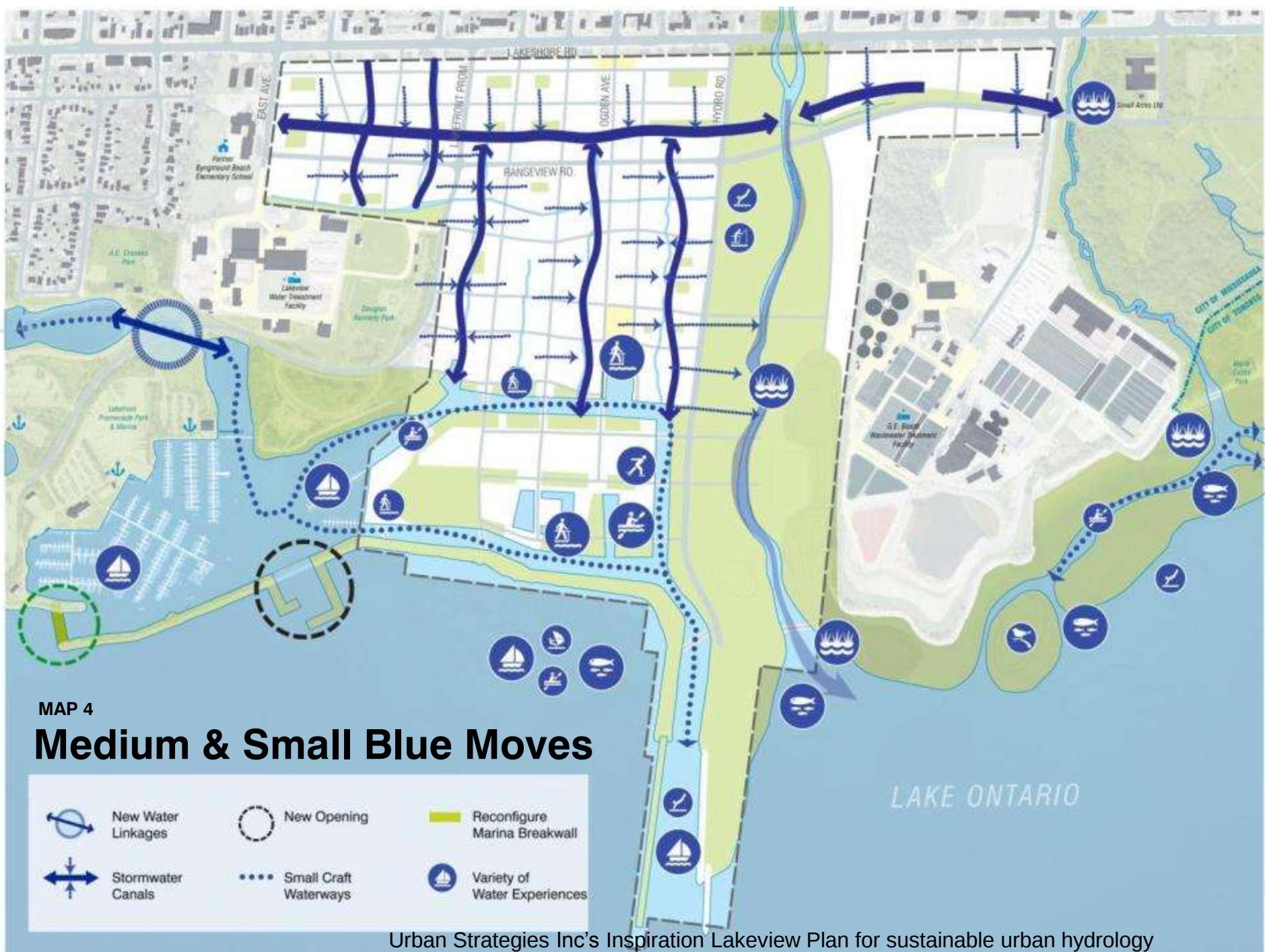
Filter and store first flush -25mm

Diagram illustrating the components of a roof drainage system:

- Roof
- Downspout
- Downspout Reconnection
- Overflow
- Downspout exchange pipe
- Downspout
- Downspout storage pipe
- Downspout Seal

Recharging Downspout Seal to keep the backflow







Digital Media for a Livable and Prosperous Ontario



Queen's Park Research

Research and Innovation
Digital Media for a Livable and Prosperous Ontario



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

[illegible]

Growth Plan for the Greater Golden Horseshoe

The Growth Plan has four major sections:

1	2	3	4
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	INFRASTRUCTURE TO SUPPORT GROWTH • Infrastructure Planning • Transportation - General • Moving People • Moving Goods • Water and Wastewater Systems • Community Infrastructure	PROTECTING WHAT IS VALUABLE • Natural Systems • Prime Agricultural Areas • Mineral Aggregate Resources • A Culture of Conservation	IMPLEMENTATION • Places to Grow Act, 2005 • Implementation Analysis • General Implementation and Interpretation • Coordination • Monitoring and Performance Measures • Public Engagement

Places to Grow – Better Choices. Brighter Future. Ontario

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

Research Leadership

Steve Easterbrook

Dept of Computer Science, UofT

Andrew Clement, Faculty of Information , UofT

John Danahy, John H. Daniels Faculty of Architecture

Paul Guild, Dept of Management Sciences, UofW

Bryan Karney, Dept of Civil Engineering, UofT

Eric Miller, Director, Cities Centre, Prof, Dept of Civil Engineering, UofT

Gerald Penn, Dept of Computer Science, UofT

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

Frank Tompa, School of Computer Science, UofW

Project Team

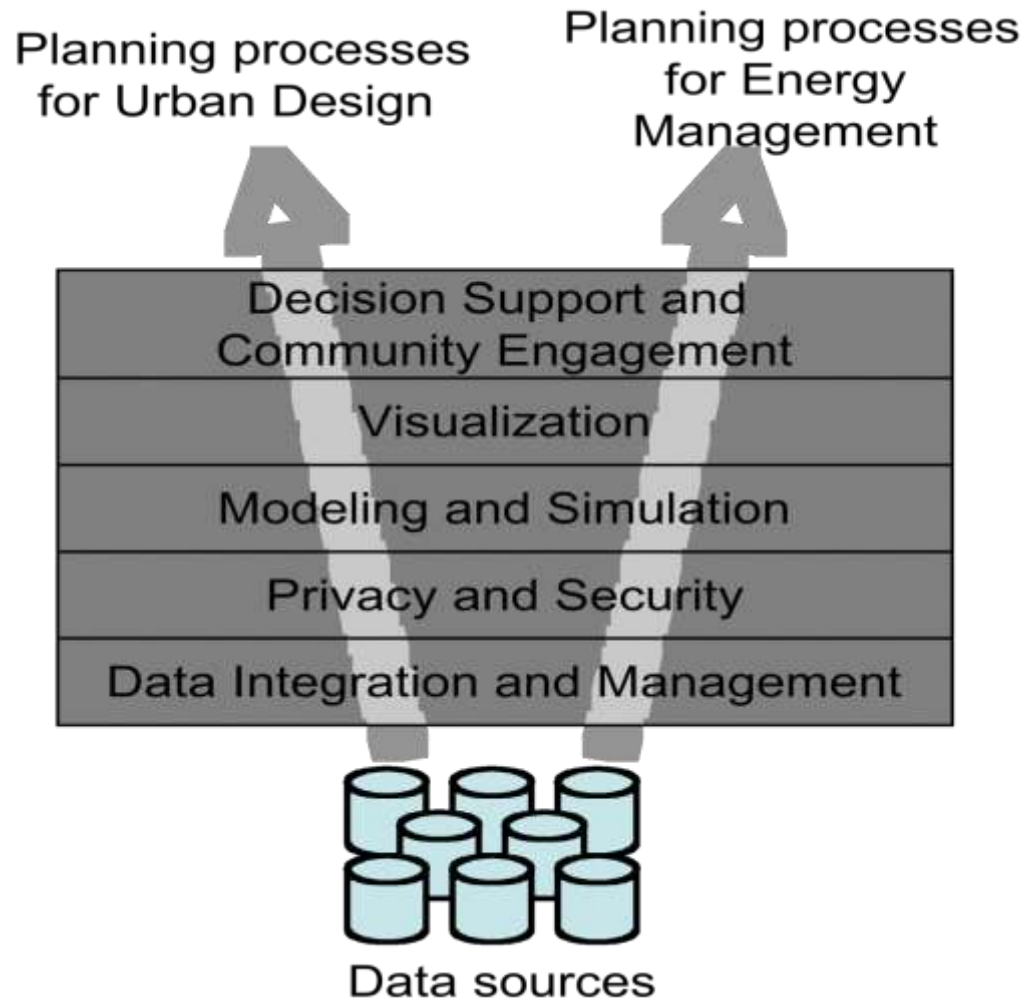
RESEARCH INVESTIGATORS

- Eric Miller, UofT
- Stephen Sheppard, UBC
- John Danahy, UofT
- Jeff Cassello, UofWaterloo
- Reob Feick, UofWaterloo
- Ron Kellet, UBC
- Chris Kennedy, UofT
- Ted Kesik, UofT
- Stephane Roche, Laval
- Rob Wright, UofT
- Kathryn Grond, UofT
- Jacob Mitchel, UofT, DTAH
- Eugene Mohareb, UofT

RESEARCH PARTNERS

- ESRI Canada,
- 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

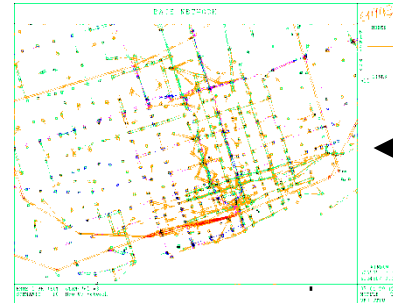
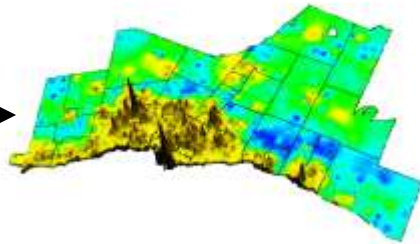
Government

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

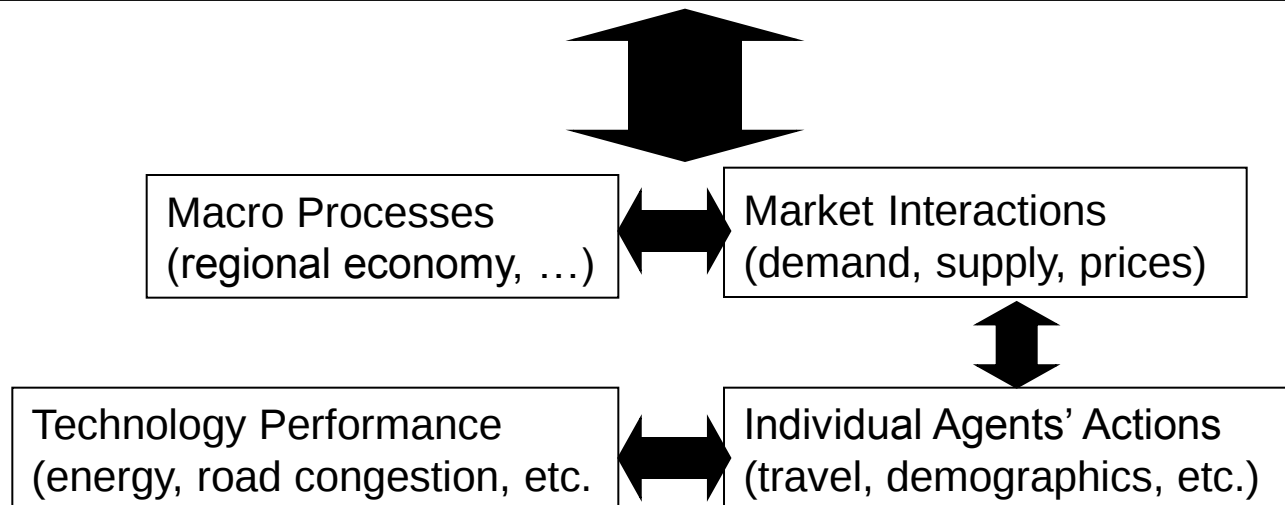
Smarter Planet: Smart Cities

- ▶ 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

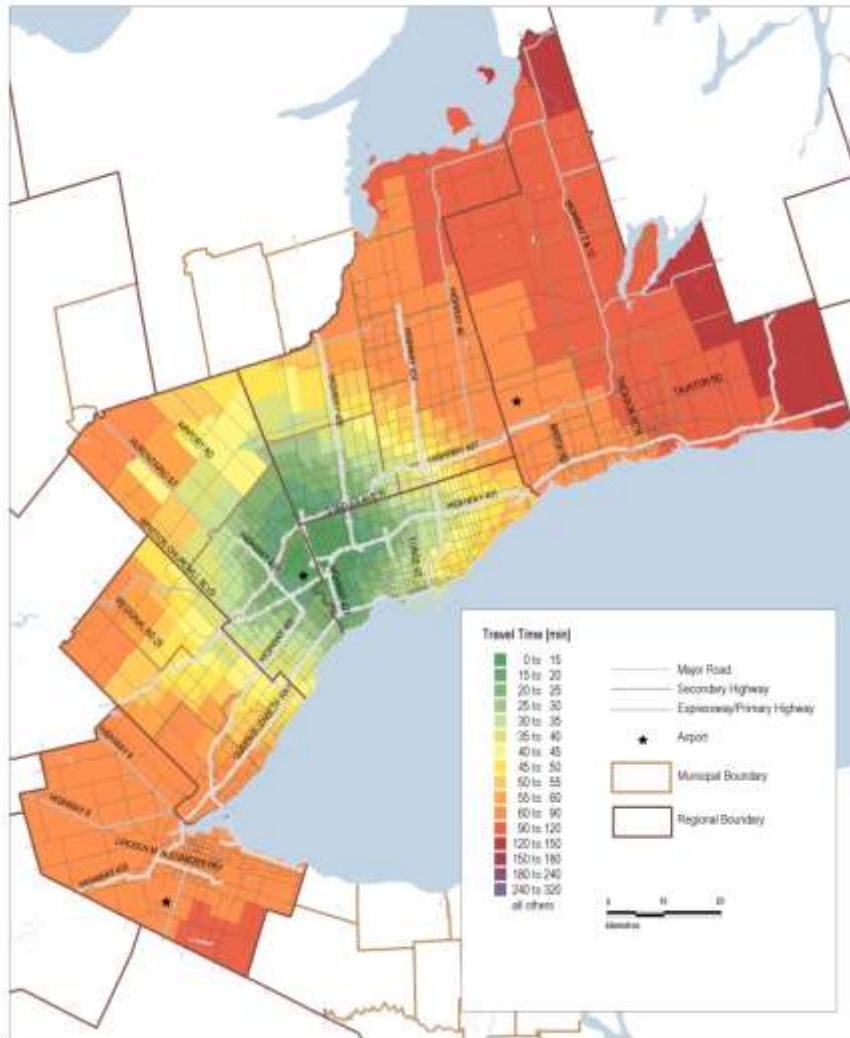


Spatial – Temporal Representation of the Physical World
(buildings, transport networks, etc.)

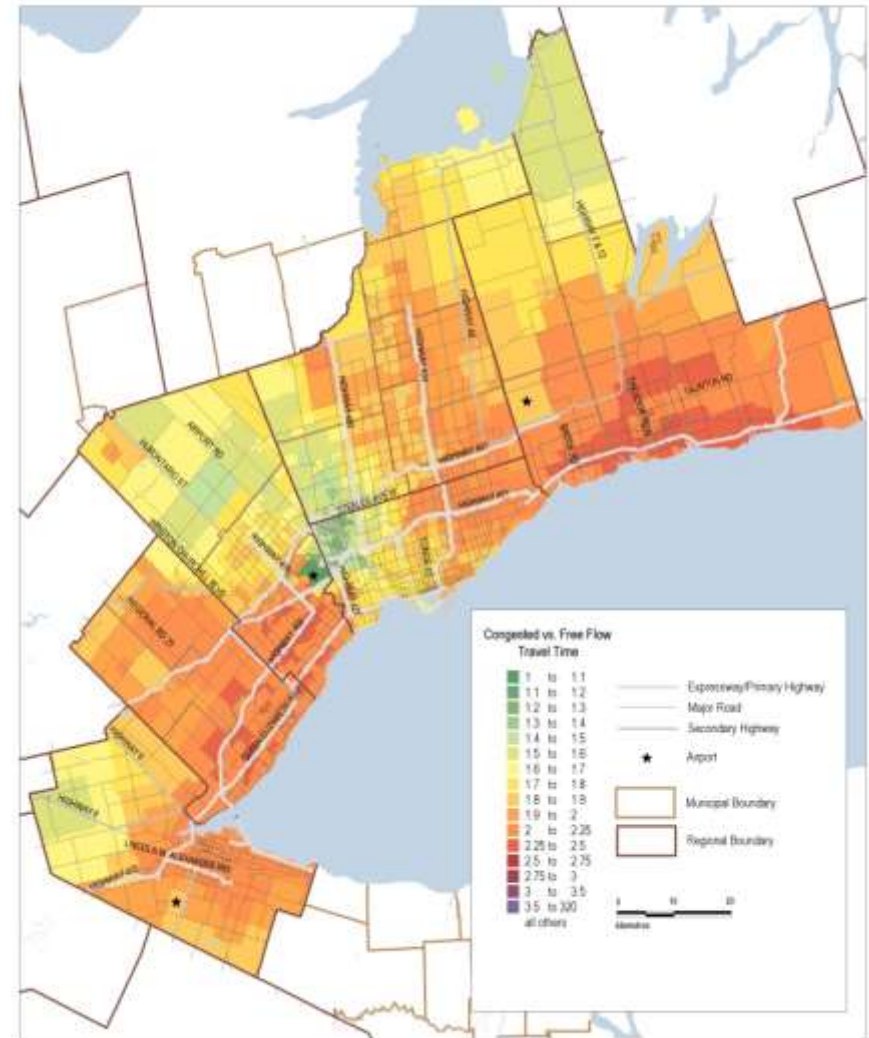


Transportation systems models

2031 AM Peak Travel Time to Pearson Airport



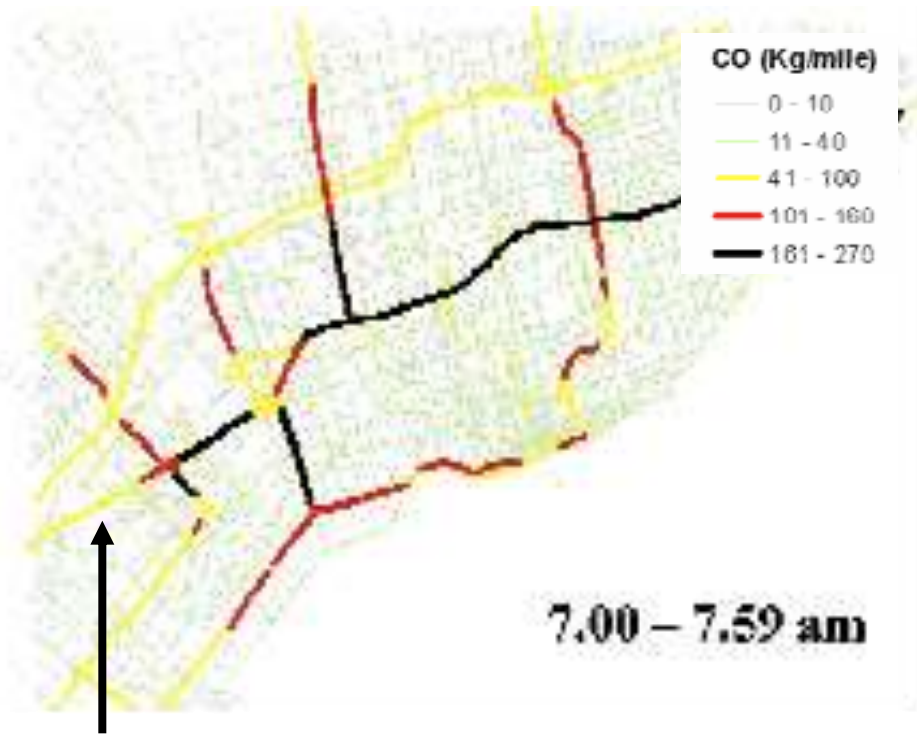
2031 AM Congestion Indices to Pearson Airport



Revised August 31, 2005

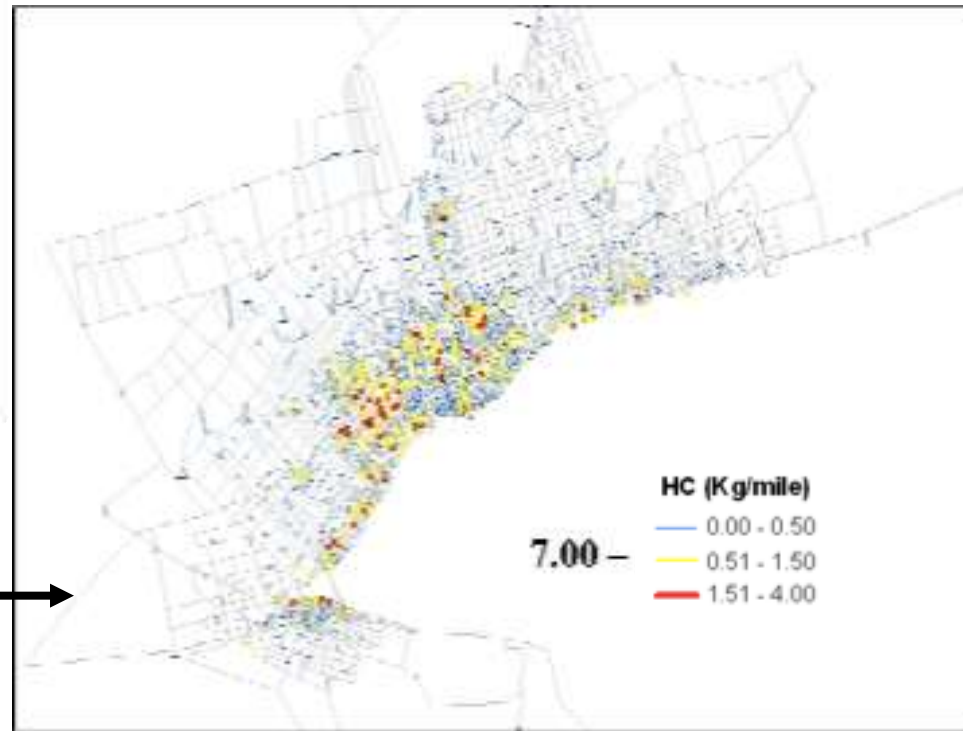
September 5, 2005

Auto Emissions by location and time of day

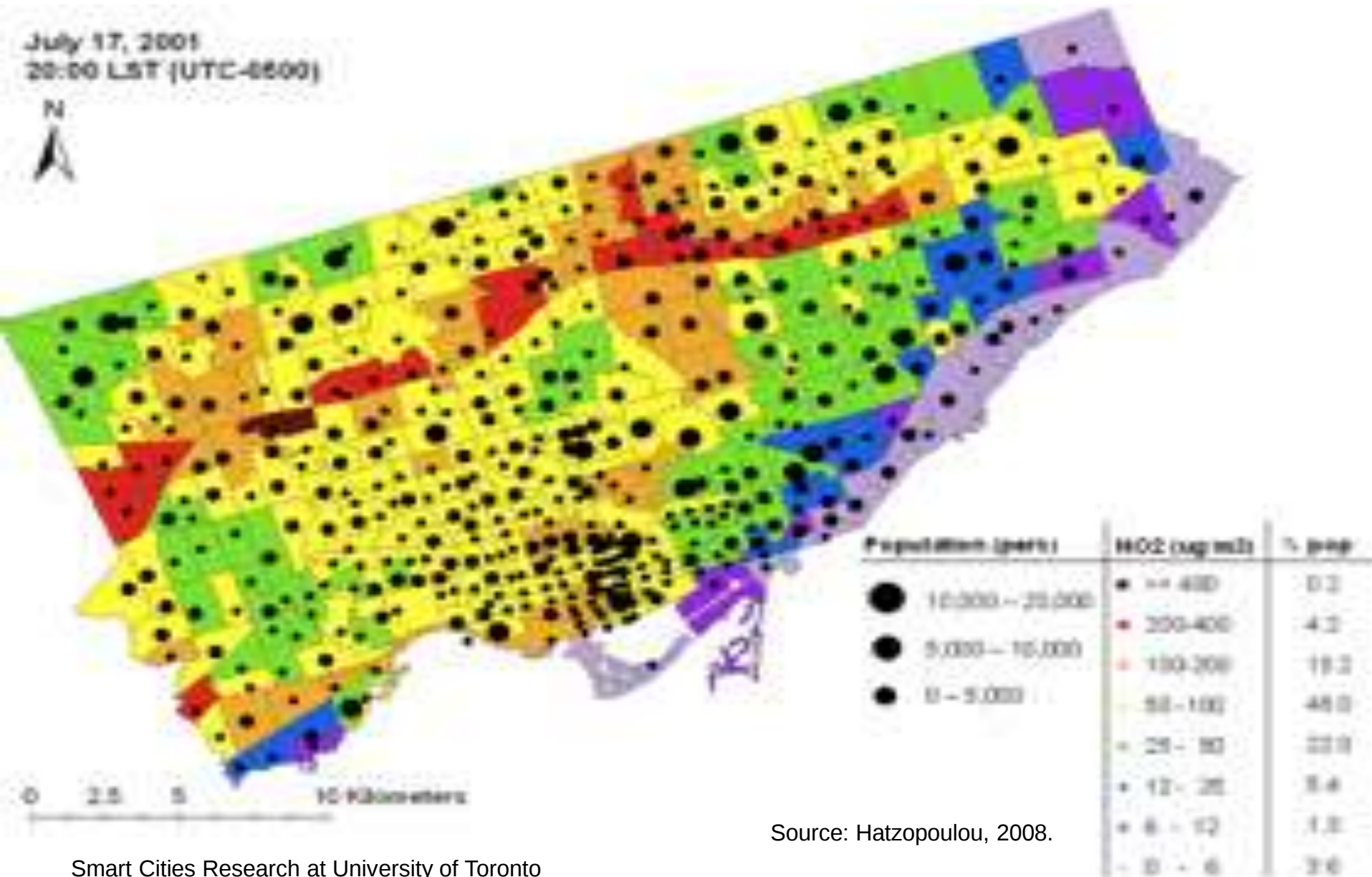


Link-based running emissions
by time of day

Zone-based soak
emissions by time of day



Pollution exposure by location & time of day



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 prototype 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



WATERFRONTToronto



Cities Centre
UNIVERSITY OF TORONTO

CLIMATE⁺

ARUP

Green Building Consultants:



Halsall



EC3 Initiative



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

SPATIAL



Front Street

Front Street is a major east-west thoroughfare creating a gracious active, residential address. At its eastern extremity, Front Street will connect with Highway 404, a curving street that aligns the edge of the Don River Park, and forms a broad, green edge to the City.

Front Street will be a wide, active street. Buildings will be 10 stories in height with continuous active use facing the ground floor. At the eastern end of Front Street, 10-story townhomes will rise from the 10-story buildings, creating a dramatic and iconic gateway to Don River Park.

Front Street is designed with a central lane area underneath a broad canopy of trees, providing places for strolling and relaxing in a park setting. This space can accommodate neighbourhood festivals and other special events. The sidewalk areas are wide to encourage pedestrian use during, shops, serving area uses, and generous planting space for trees and attractive ground cover. The street itself provides space for on-street parking, bike lanes, and pedestrian travel lanes.

The overall proportions of the street cross section are in accordance with the City's design guidelines for space and light.

Buildings are designed with emphasis on the right-of-way to increase sunlight penetration. The facade composition should not be multiple horizontal divisions within each block to reduce the chance of continuous horizontal expressions.



Urban Performance Models

Traffic Model

Population model (population synthesis)

TASHA : Trip Planning

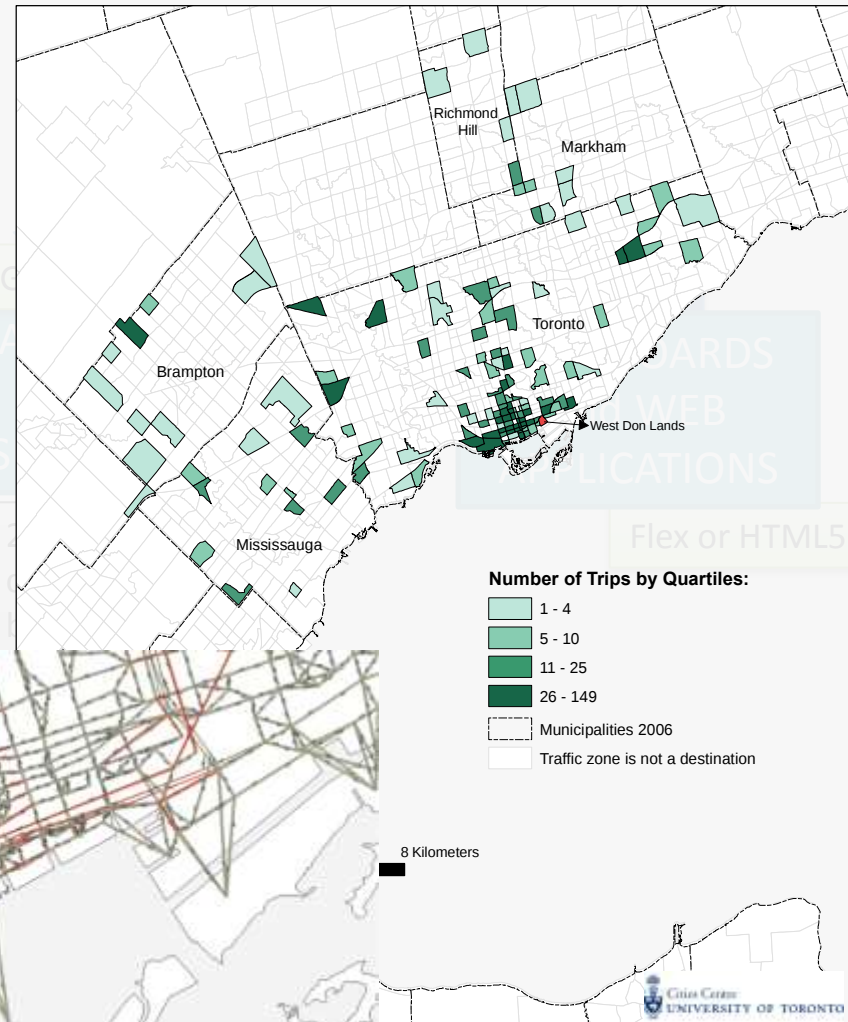
EMME2: Traffic Assignment

URBAN PERFORMANCE MODELS

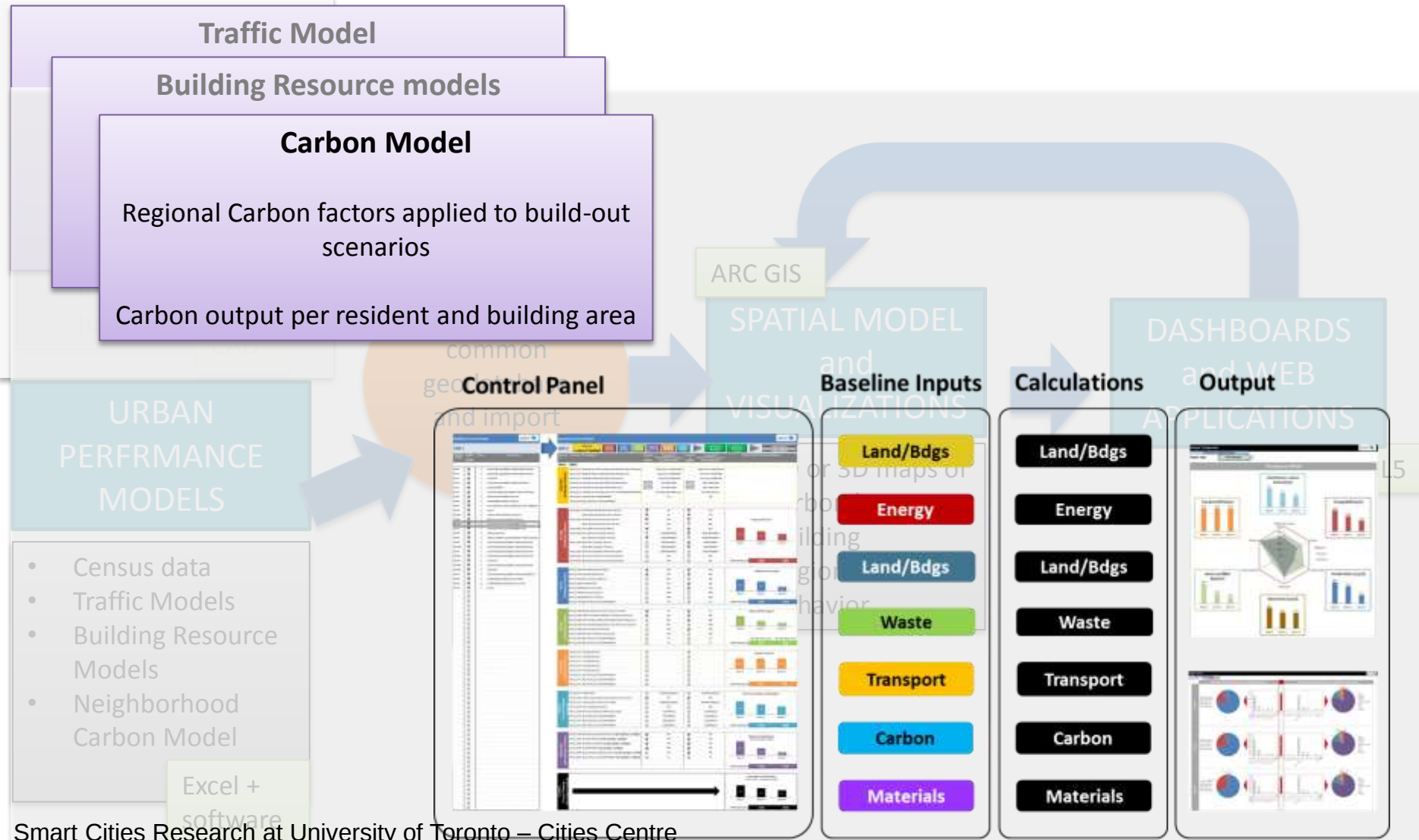
- Census data
- Traffic Models
- Building Resource Models
- Neighborhood Carbon Model

Excel + software

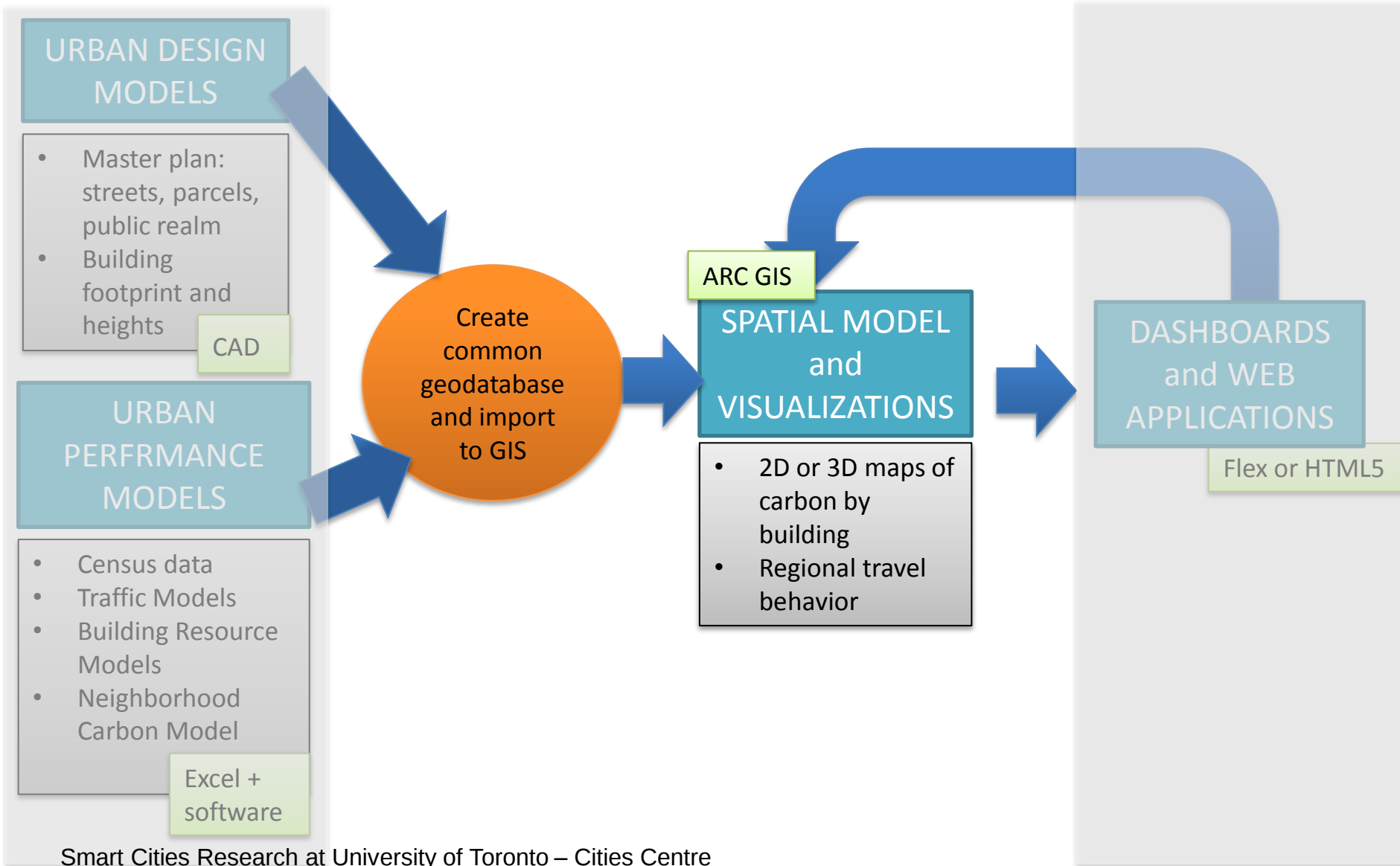
Work Trip Destinations for Residents of West Don Lands
TTS Traffic Zones 2001

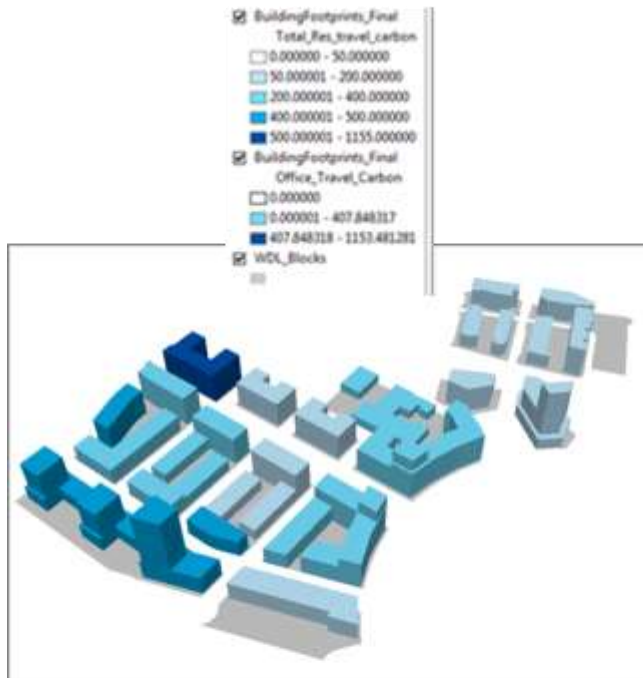


Urban Performance Models



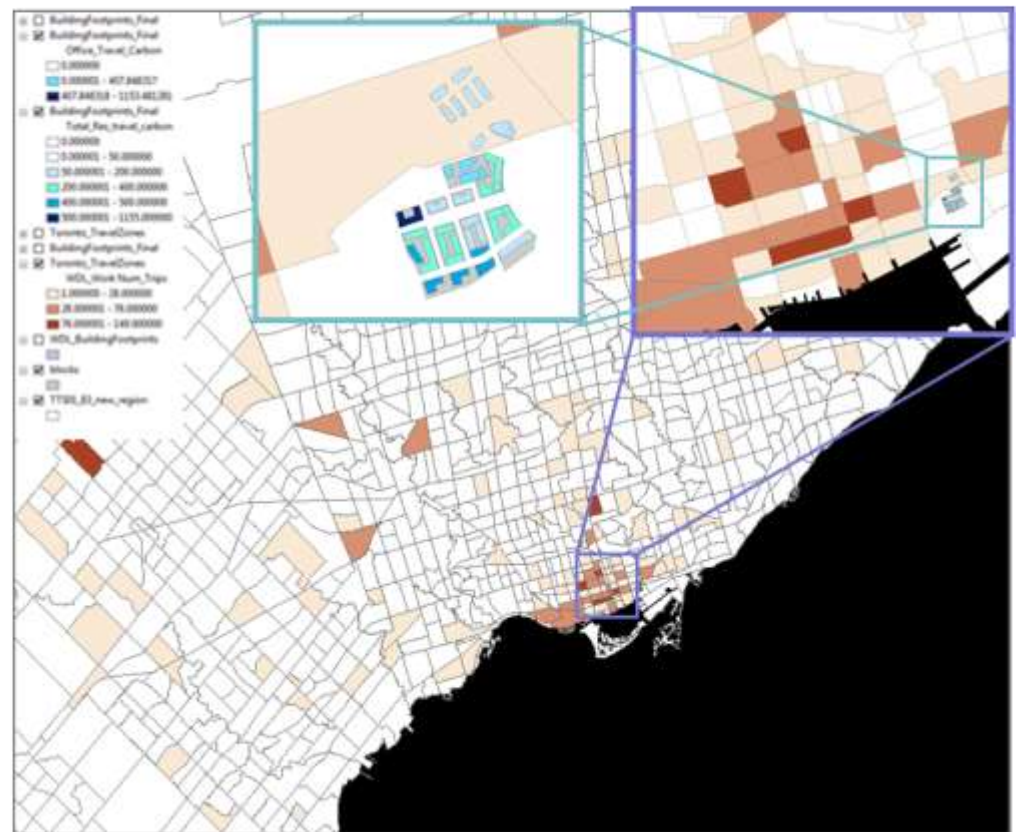
Spatial Models





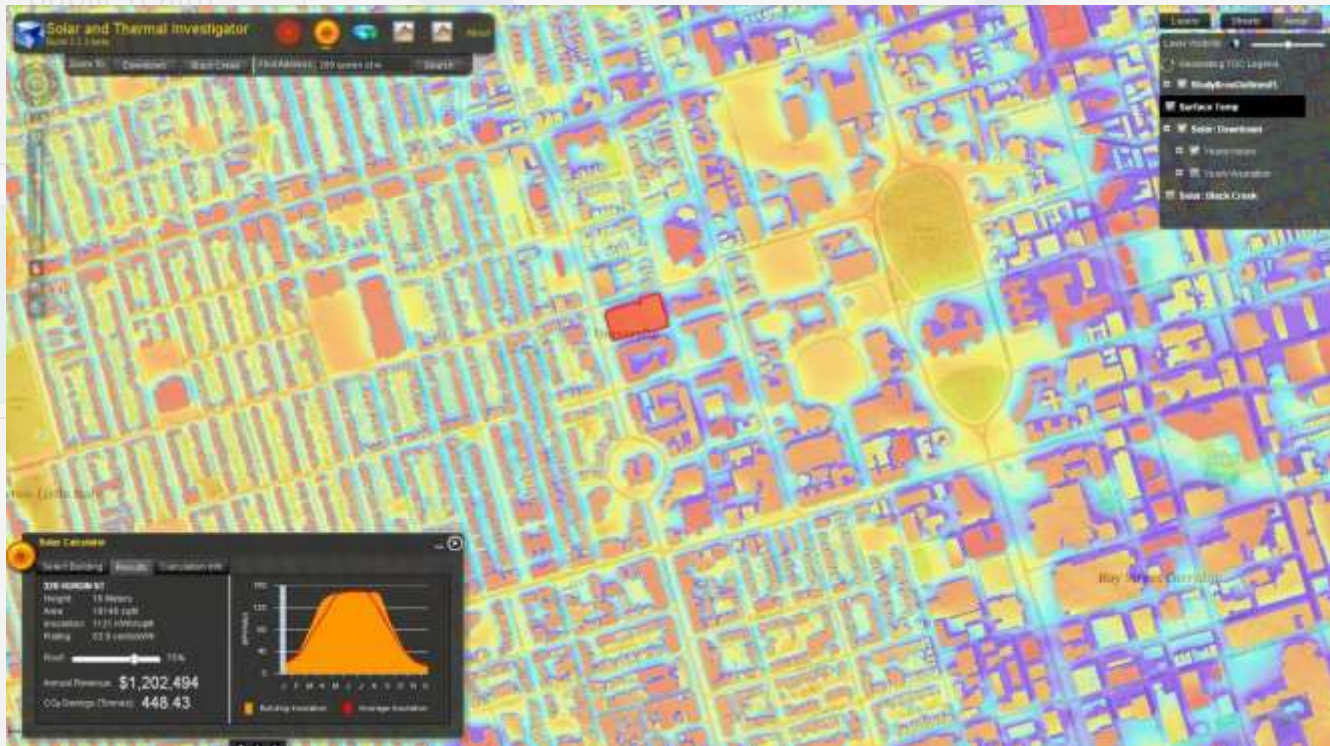
Carbon generated by resident and employee travel (tons CO2)

Destination of resident work trips in the region (number of trips)



Dashboards

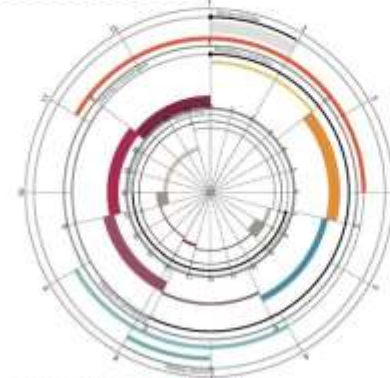
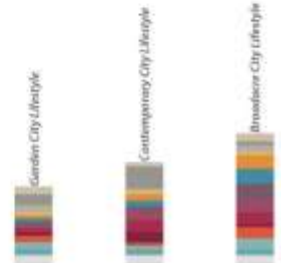
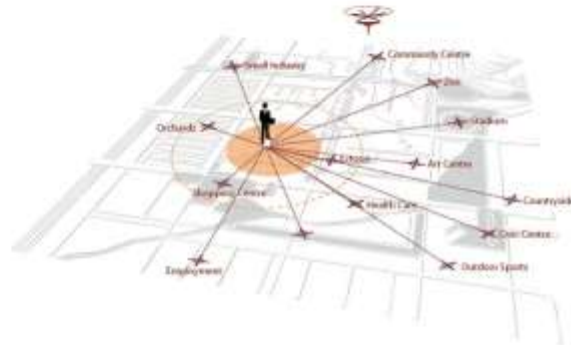
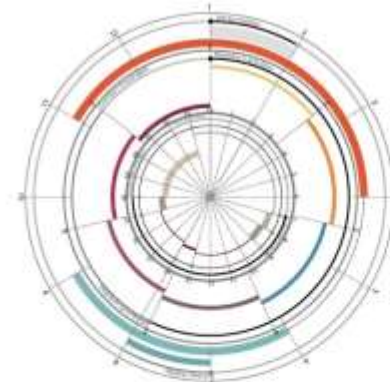
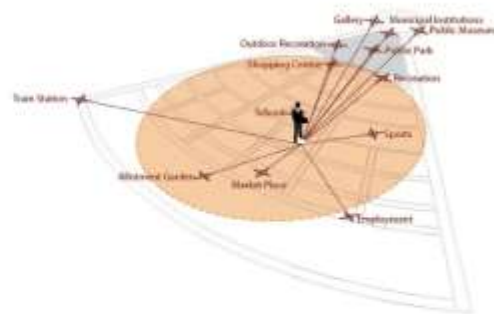
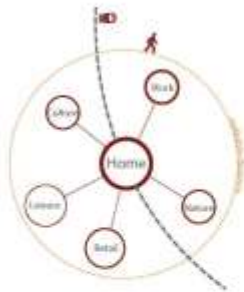
Dashboard can create opportunities for the public and experts alike to test options, such as individual building and roof potential for Solar PV applied to Provincial funding



DASHBOARDS
and WEB
APPLICATIONS

Flex or HTML5

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



Three Urban Form & Lifestyle Choices for Garden City, Contemporary City and Broadacre City, as shown in Table 1. The three Urban Form & Lifestyle Choices are based on the three different levels of environmental, economic, and social sustainability. The three Urban Form & Lifestyle Choices are based on the three different levels of environmental, economic, and social sustainability.

Garden City Lifestyle
The Garden City Lifestyle is based on the Garden City concept, which is a model of urban development that emphasizes the integration of nature and urban form. The Garden City Lifestyle is based on the Garden City concept, which is a model of urban development that emphasizes the integration of nature and urban form.

Contemporary City Lifestyle
The Contemporary City Lifestyle is based on the Contemporary City concept, which is a model of urban development that emphasizes the integration of nature and urban form. The Contemporary City Lifestyle is based on the Contemporary City concept, which is a model of urban development that emphasizes the integration of nature and urban form.

Broadacre City Lifestyle
The Broadacre City Lifestyle is based on the Broadacre City concept, which is a model of urban development that emphasizes the integration of nature and urban form. The Broadacre City Lifestyle is based on the Broadacre City concept, which is a model of urban development that emphasizes the integration of nature and urban form.

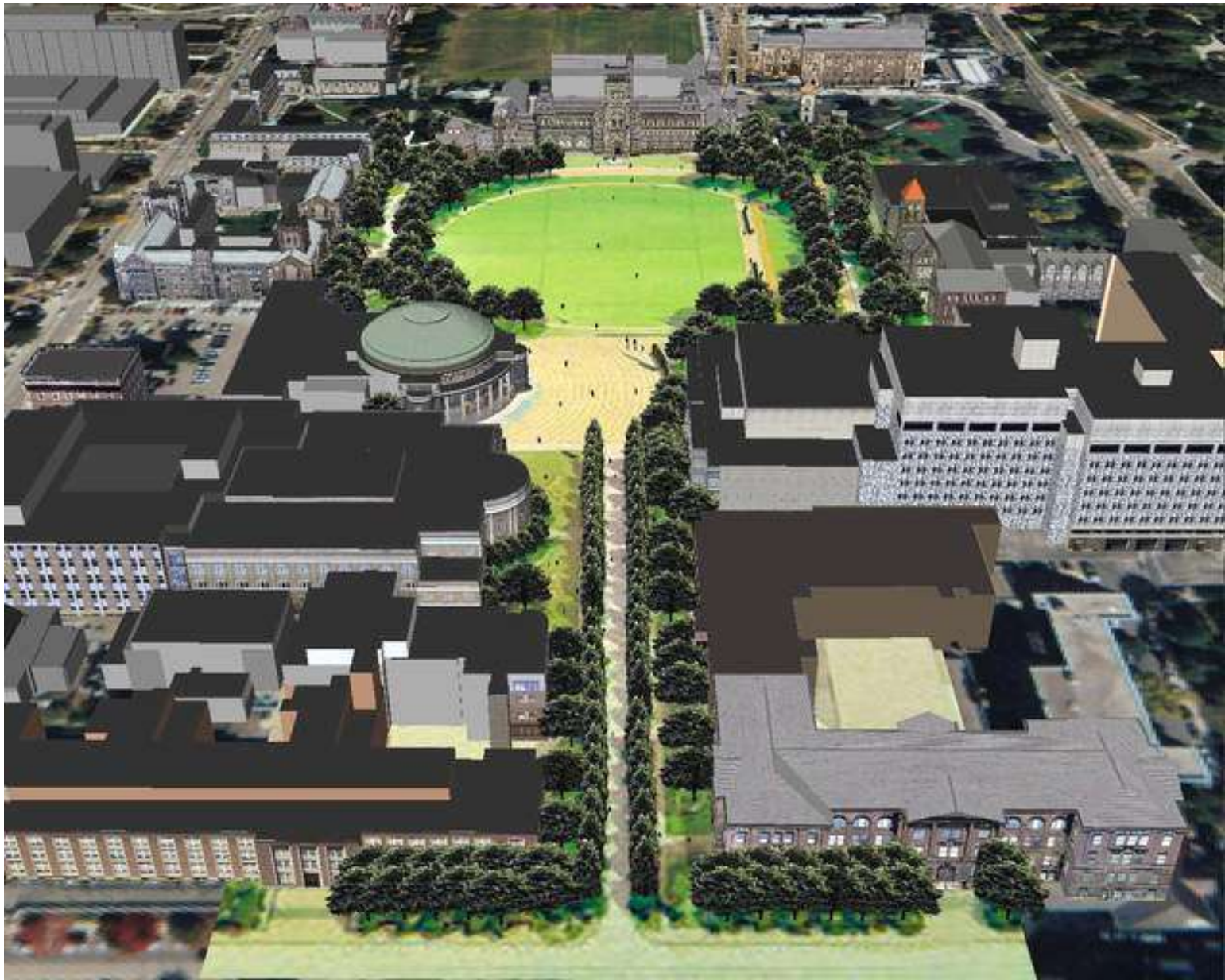
Decision Support Techniques

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

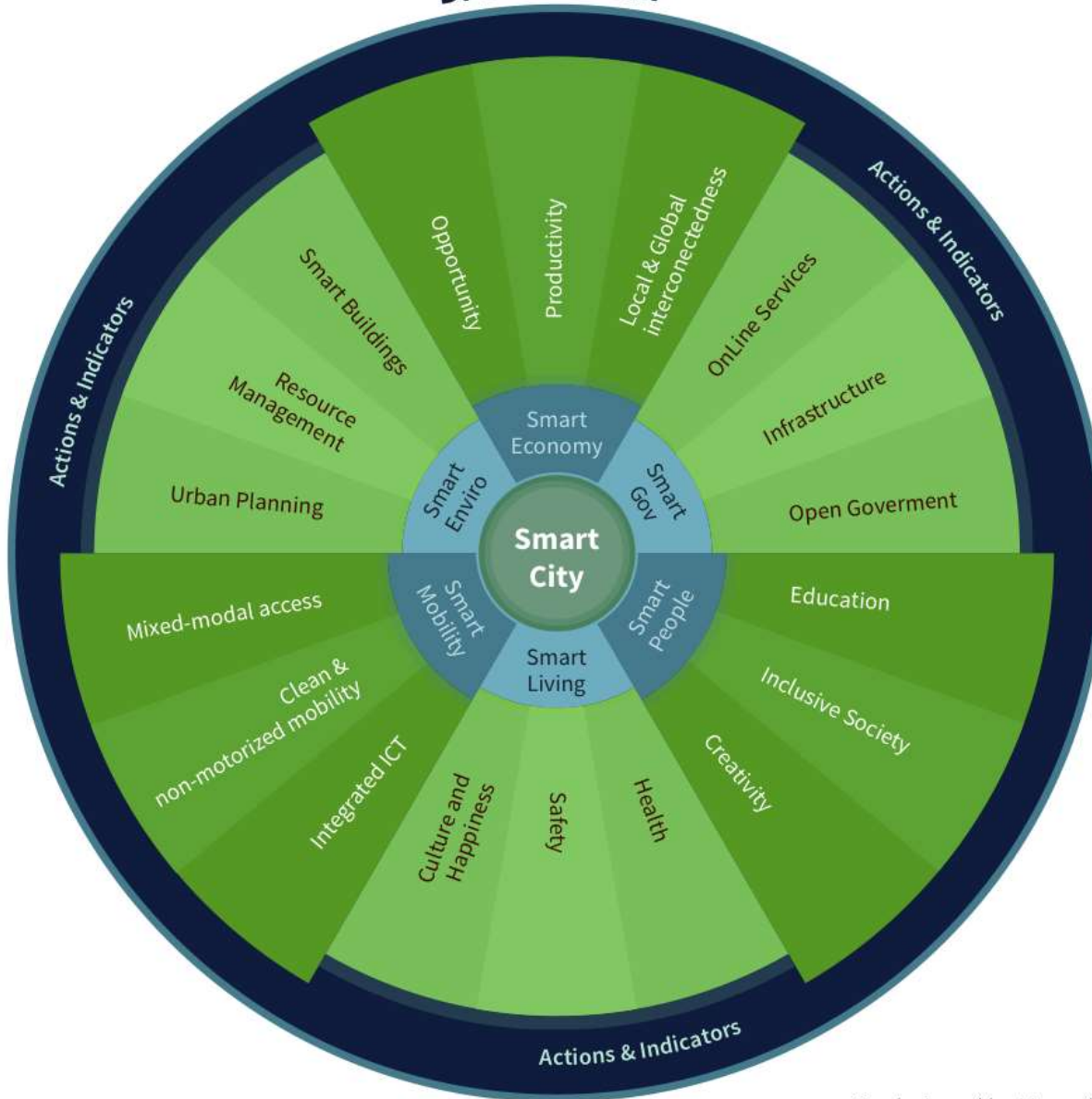


CLR – 3D City Models that “Show Me” the integration of smart cities thinking from metrics to human scale experience

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.

BY BOYD COHEN



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>

Re-designed by Manuchis.



Singapore—The Next-generation Smart City

Singapore aims to have 80% of all its buildings meet its minimum 'Green Mark Certified' energy efficiency standards by 2030.

Key Aspects of Singapore Smart City, Asia-Pacific, 2013

Smart Energy

- 90% to 95% of electricity generated from natural gas
- Smart grid systems installed in more than 30% of the households

Smart Healthcare

- Integrated health information system across Singapore
- Cloud computing models used in most healthcare organizations

Smart Technology

- 100% broadband penetration rate
- Initialization of 4G LTE service
- 50% of households to have smart home solutions

Smart Citizen

- One in two residents to commute to work by public transport
- 100% population with access to sanitation
- Target to recycle 65% of waste by 2020

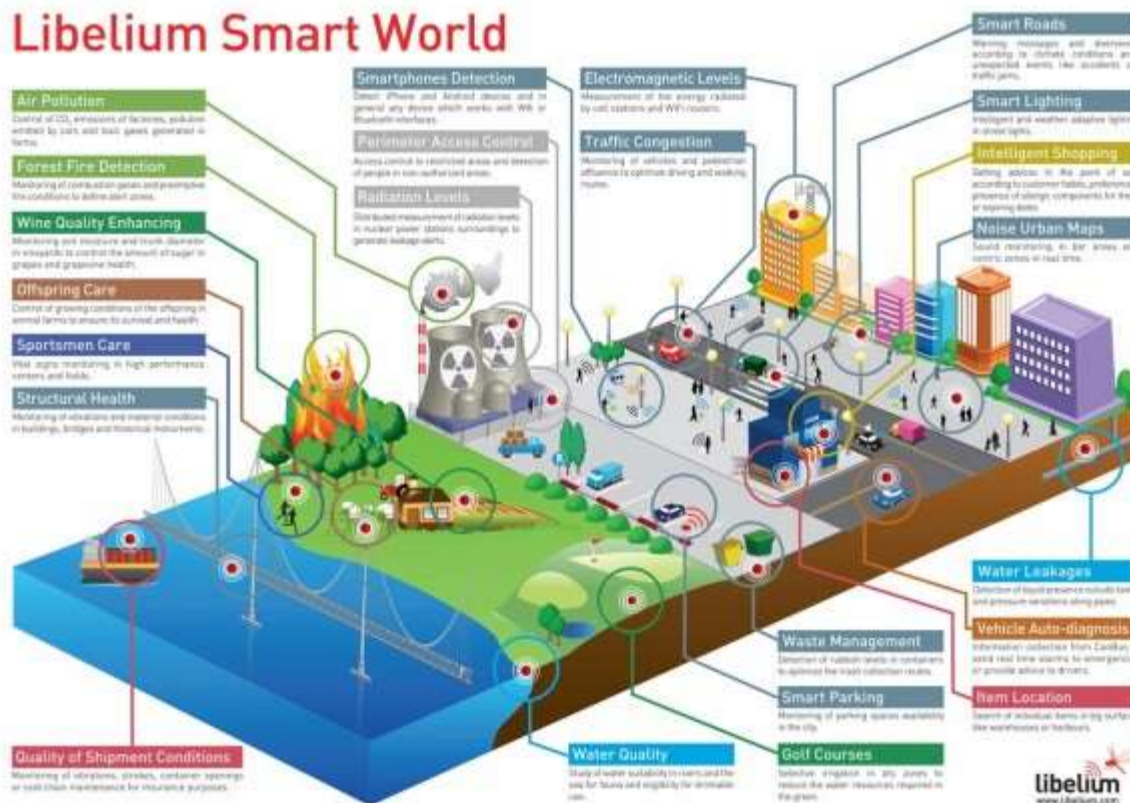
Smart Governance

Establishment of Inter-Ministerial Committee on Sustainable Development to create Singapore's national strategy on sustainable development

Smart Mobility

- 70% of traffic to be public transport by 2020
- Availability of real-time travel information on internet and mobile phones
- 40% rebate on purchases of green vehicles, such as hybrid, electric cars, etc.

Libelium Smart World



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.



Universities & Smart Cities: A Global Perspective

Dr. Mark Gerber, President, University of Toronto
Address to the Observer Research Foundation





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.

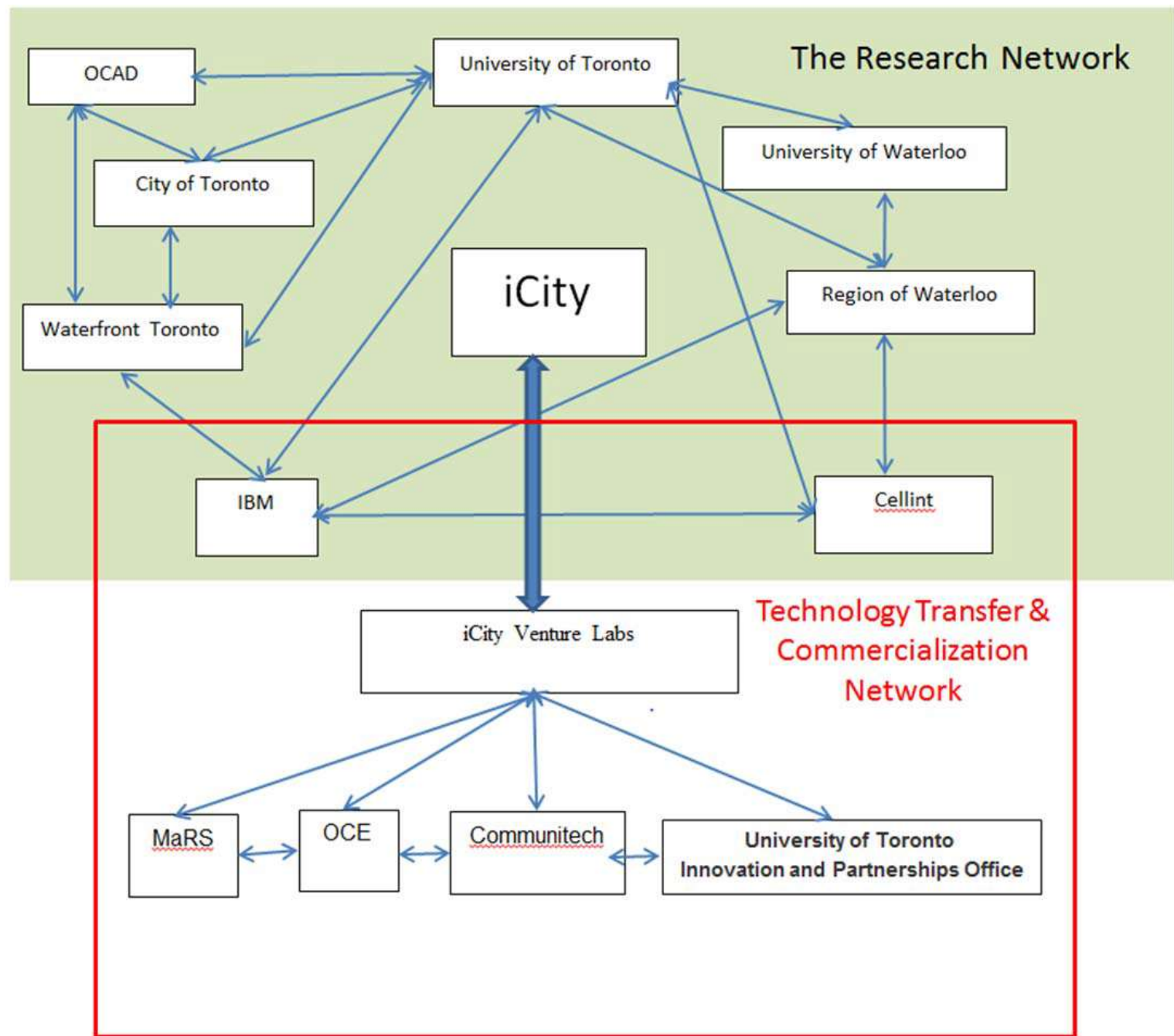
Bringing together the University Talent & Creating Research Catalogues

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

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



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.

