

MIT Quantitative Methods

Massachusetts Institute of Technology

Urban Transportation Planning
MIT Course 1.252j/11.380j
Fall 2006

Mikel Murga, MIT Research Associate and Lecturer

- From road counts to ...
- The 4-Step Model
- Critique
- Integration of the analytical chain
- New Trends

From road counts ... to a Light Rail

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F.Salvucci and M.Murga

From road counts...

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- ... to origin-destination matrices:
 - By using heuristic methods to obtain an o-d matrix
 - Or by conducting surveys among drivers
 - Or even by updating an old o-d matrix

- Why an o-d matrix?
 - To assign that o-d matrix under “what if”
 - To test closing a street or other tactical short term measures
 - To analyze the impact of a New Light Rail

- ... Then why use a 4-step model?

From vehicle counts to traffic models

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- 
- Highway Capacity Manual:
 - Hand-calculations → HCS
 - Macroscopic Models:
 - Representation of Platoons
 - Microscopic Models
 - Individual vehicles are analyzed

Data availability + Computer power

We could use Lafayette counts...

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Saturation flows anyone??

Using Lafayette counts...

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2000 Signals - [LAFAYETTESIGNALS1]

Edit View Window Help

Input Quick Jump Report Quick Jump

SIGNALIZED INTERSECTION

MM
MIT
10/13/2004 Units: U. S. Customary
Morning peak
Mass Av

METRY and VOLUME Quick

Eastbound Westbound

Thru Right Left Thru Right

HCS2000: Signalized In

yst: MM
cy: MIT
: 10/13/2004
od: Morning peak
ect ID:
St: Mass Av

SIGNALIZED I

	Eastbound			Westbound	
	L	T	R	L	T
Lanes	1	1	0	1	1
nfig	L	TR		L	TR
me	150	300	0	75	475
Width	12.0	12.0		12.0	12.0
Vol			0		

tion 0.25 Area Type: CBD or Similar
Signal Operations

Signal Combination	1	2	3	4	5	6	7	8
Left	P				NB Left			

Geometry Quick Entry - [LAFAYETTESIGNALS1]

Volumes

100 50 100 0 OK Cancel

Left Thru Right Peds



Using Lafayette counts....

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HCS2000 Signals - [LAFAYETTESIGNALS1]

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Cut PHASING DESIGN

Phase 1	Phase 2	Phase 3	Phase 4																																																																																																
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Screenshots courtesy of McTrans, used with permission.



Using Lafayette counts... Oops!

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HCS2000 Signals - [LAFAYETTESIGNALS1]

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RESULTS

Eastbound			Westbound			Northbound			Southbound		
L	TR		L	TR		LTR			LTR		
Lane Group Adjusted Volume, (vph)											
167	333	0	83	528	0	0	278	0	0	445	0
Lane Group Capacity, (vph)											
159	391		167	409			258			502	
Lane Group v/c Ratio											
1.05	0.85		0.50	1.29			1.08			0.89	
Critical Lane Group											
#			#			#			#		
Lane Group Delay, (sec/veh)											
132.4	53.7		54.6	184.0			122.0			62.8	
Lane Group Level of Service											
F	D		D	F			F			E	
Final Unmet Demand, (v)											
2.0	0.0		0.0	29.7			5.0			0.0	
Approach Delay, (sec/veh)											
80.0+			166.4			122.0			62.8		
Approach Level of Service											
F			F			F			E		
Cycle Length 105.6 sec Intersection Delay 111.0 sec/veh Intersection LOS F											

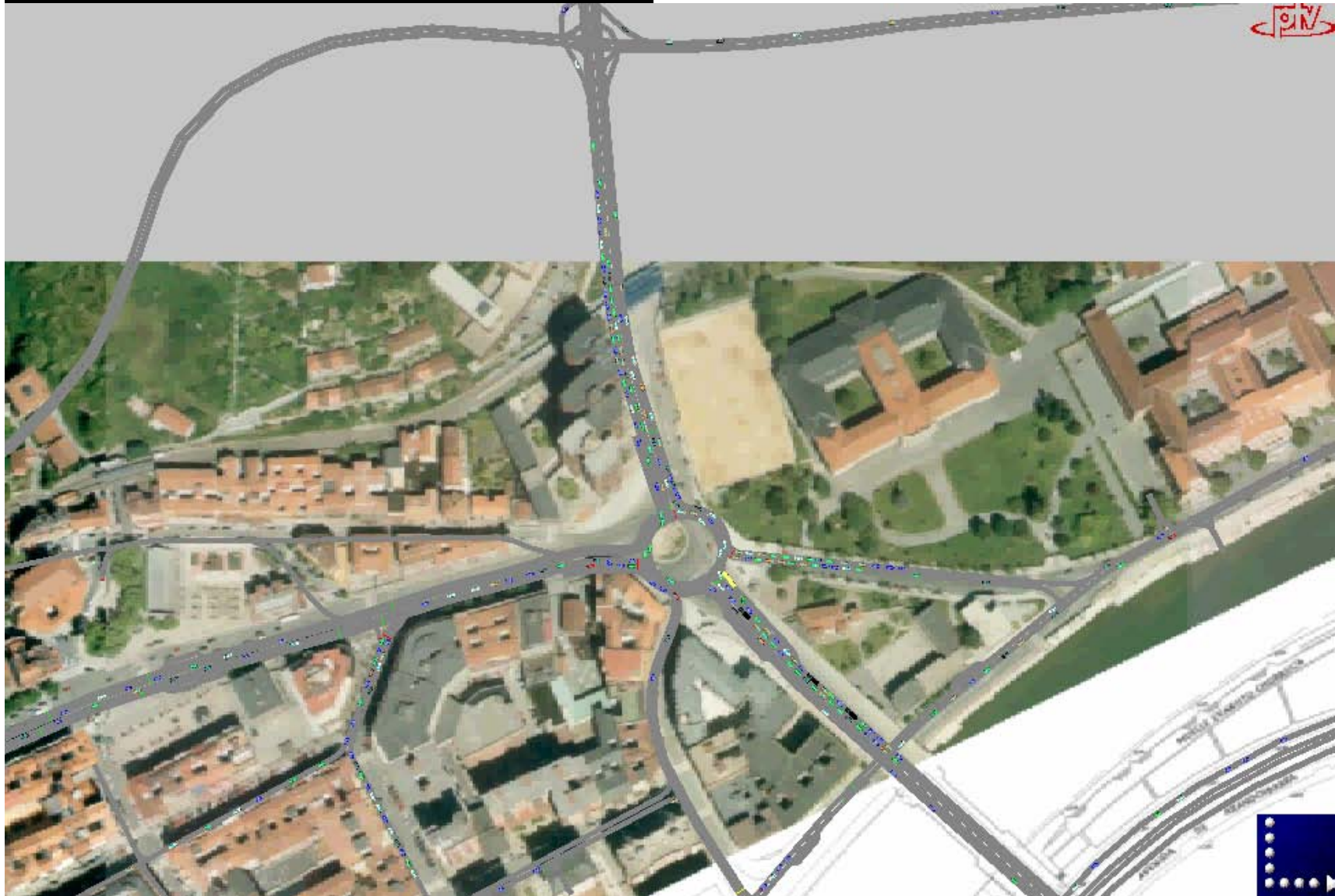
Microscopic Traffic Models

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- From research tools (MITSIM for the Big Dig) towards daily practice
- Commercial packages:
 - VISSIM
 - Aimsun
 - CORSIM – Traf-Netsim
 - Paramics
 - TransModeller
 - Dynasim
 - And many others

Microscopic models...

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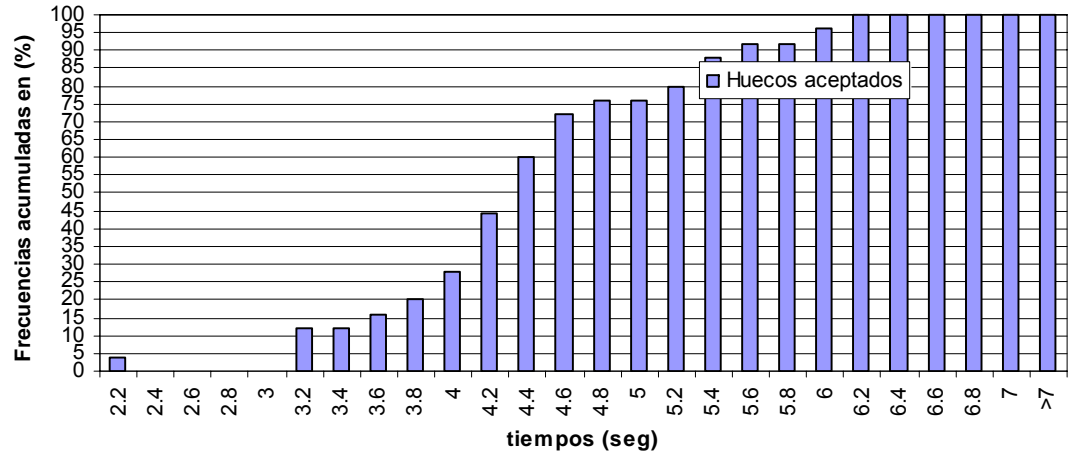
F.Salvucci and M.Murga

Microscopic Simulation: Example of Req'd Data

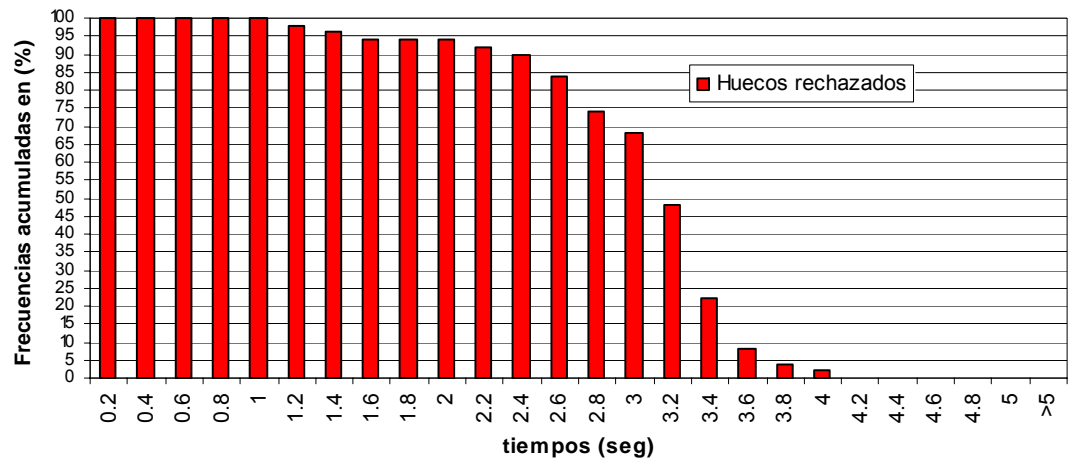
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Acceptable Gaps (from Pte.Deusto)

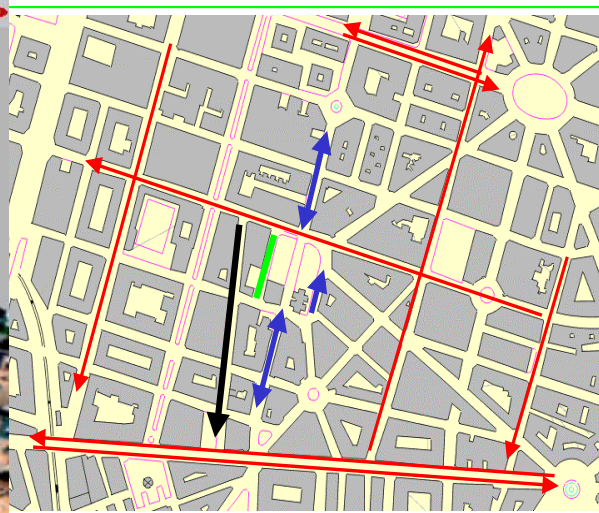


Unacceptable Gaps (from Pte.Deusto)



Microscopic Simulation: Assignment plus Visualization

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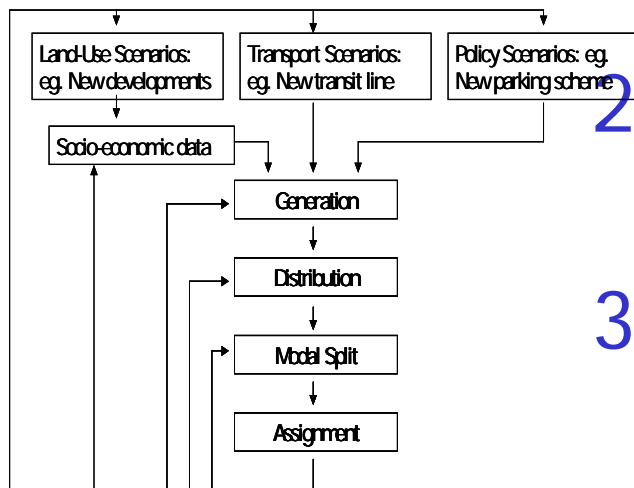


Using street assignments to save a plaza

4-Step Models: *The 4 Basic Questions*

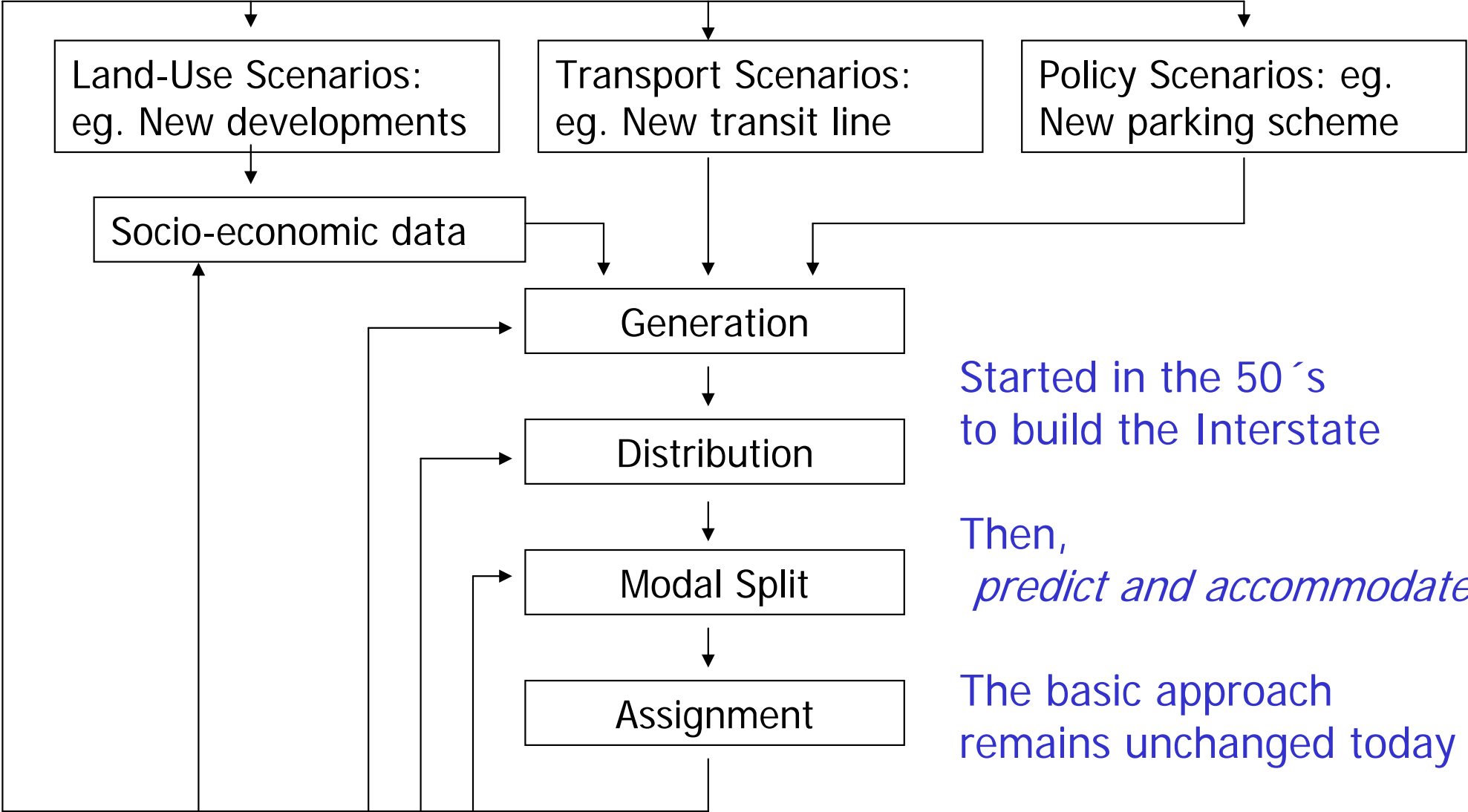
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1. How many trips are generated and attracted at any given location?
2. How many trips go from a given location to all other locations?
3. Which transport mode will be chosen to go from that location to each destination?
4. Which road will be taken for car trips and which train line for transit trips?



4-Step Planning Model

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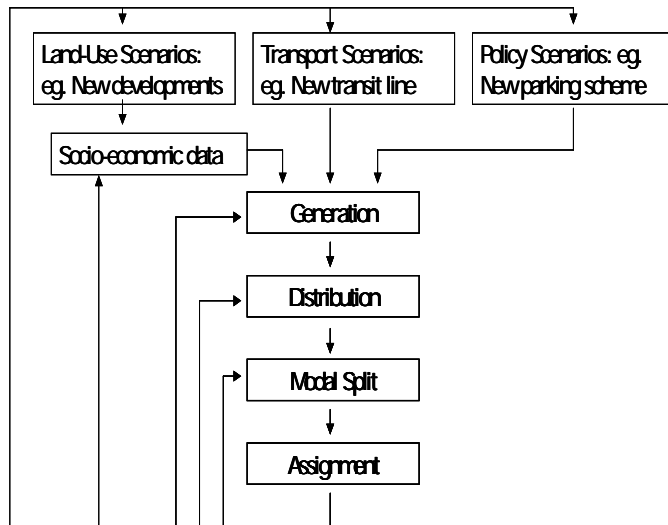
Started in the 50's
to build the Interstate

Then,
predict and accommodate

The basic approach
remains unchanged today

4-Step Models: *Three Building Blocks*

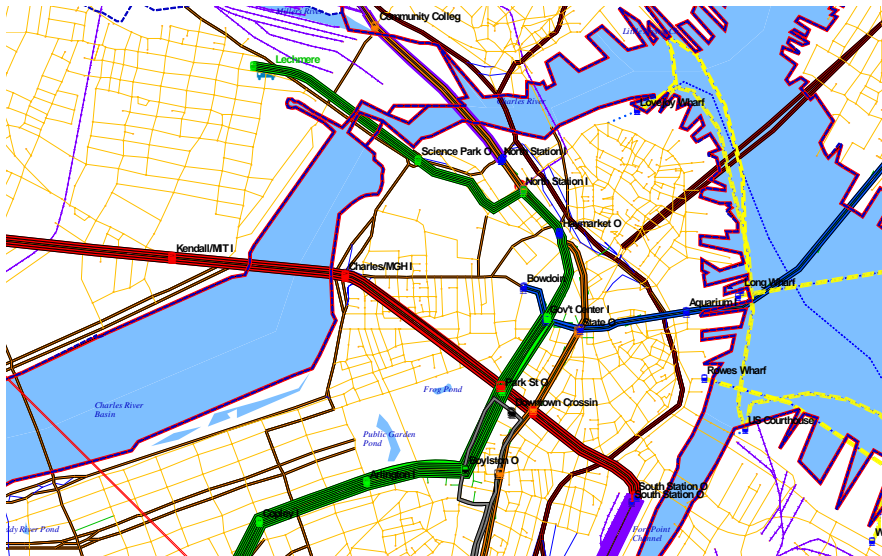
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1. **Travel Network** : road network, transit system, with all its parameters (speeds, frequencies, costs...)
2. **Socio-economic data**: number of dwellings, jobs, shops, household profiles: age, size, income ..
3. **Logic of Behavioral Patterns**: Observed or revealed behavior from travel home surveys, road counts, transit passenger surveys, in terms of trip purpose, time of day, choices made, travelers reactions to system changes, etc.

Block 1: Network Model: *Roads, Streets, Transit*

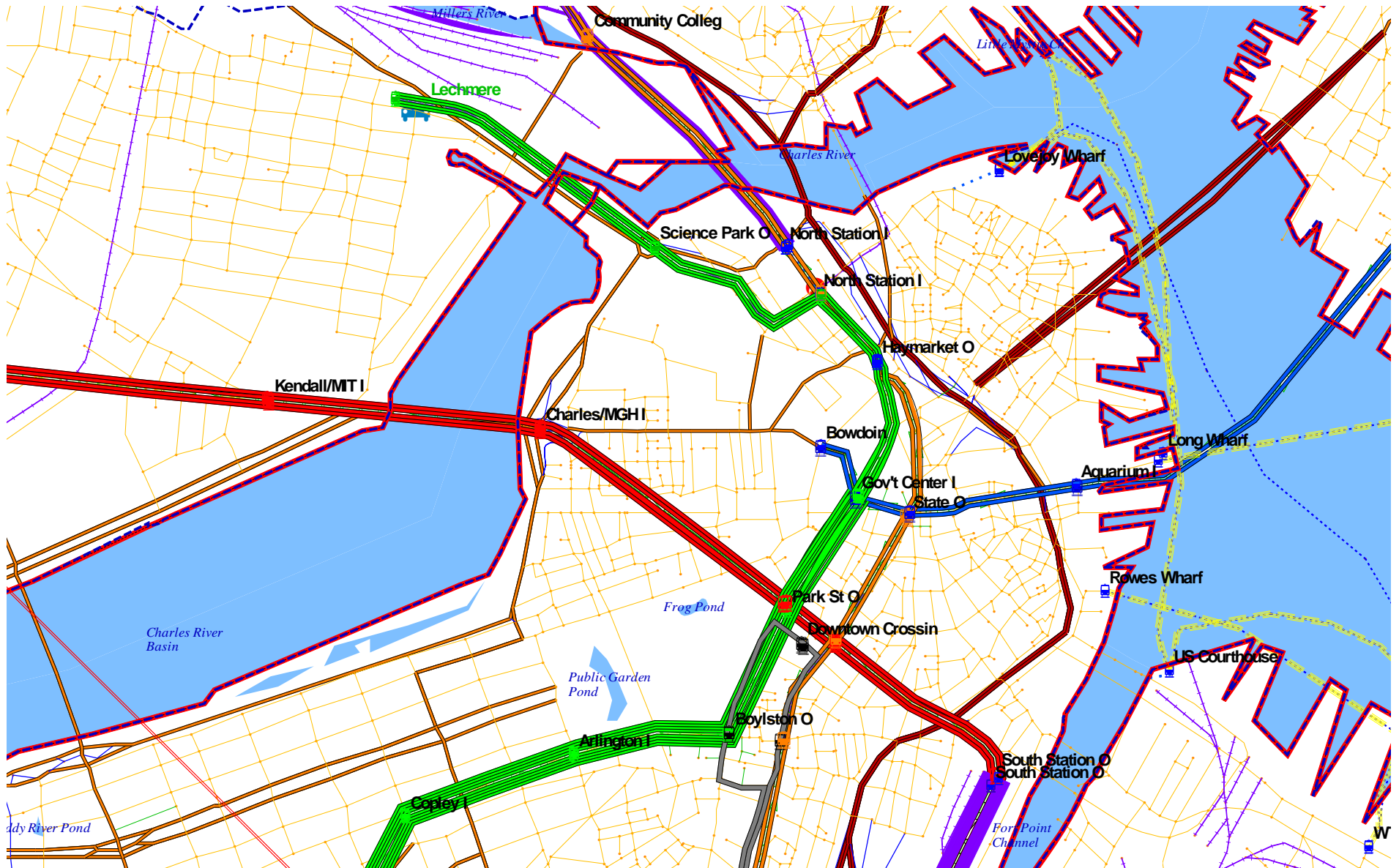
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- Data of the road system: posted speed, speeds during peak hours, capacity, traffic regulation...
- Data of the transit system: Routes, stops, commercial speeds, service frequencies...

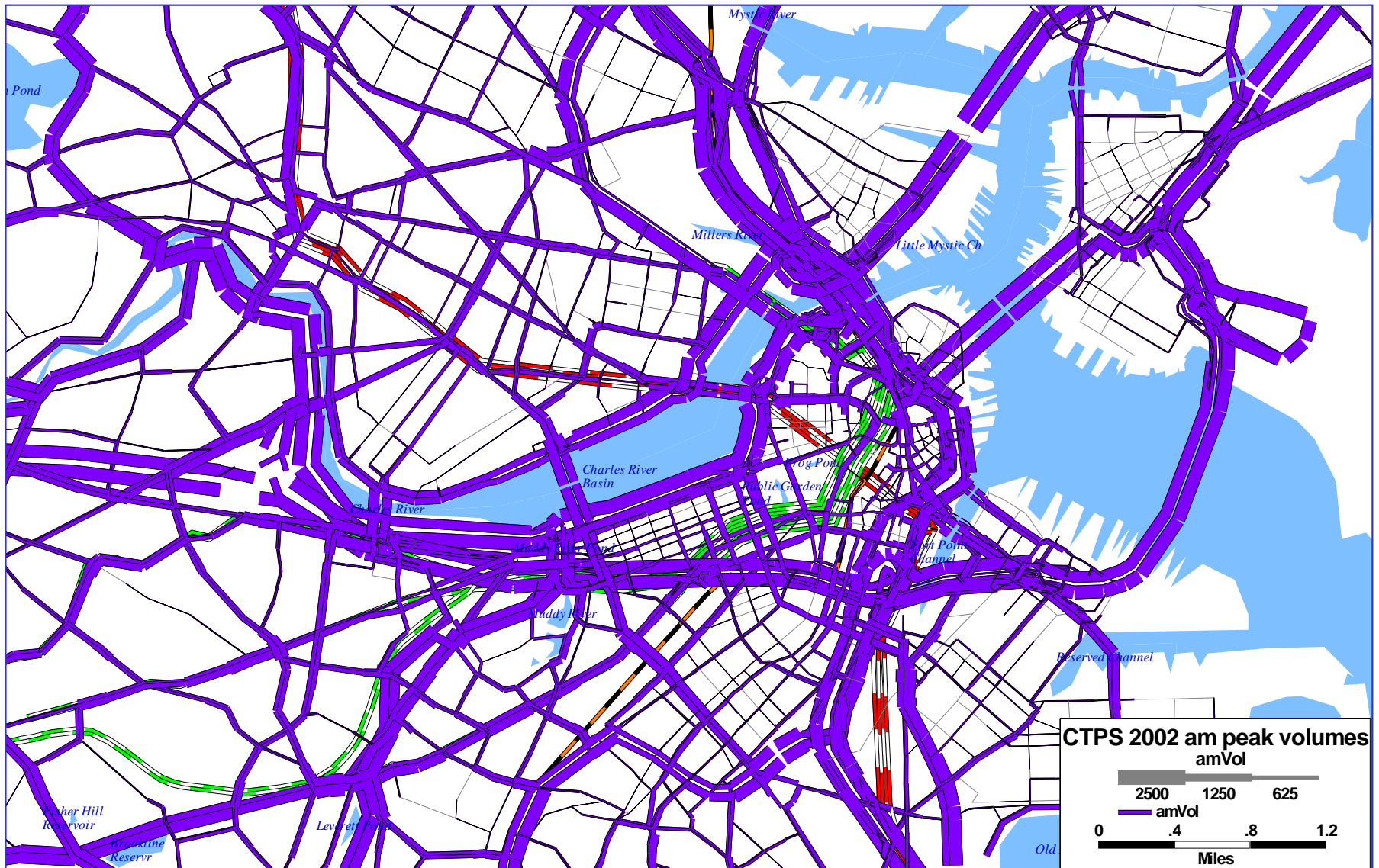
Block 1: Network Model: *Roads, Streets, Transit*

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Block 1: the road network

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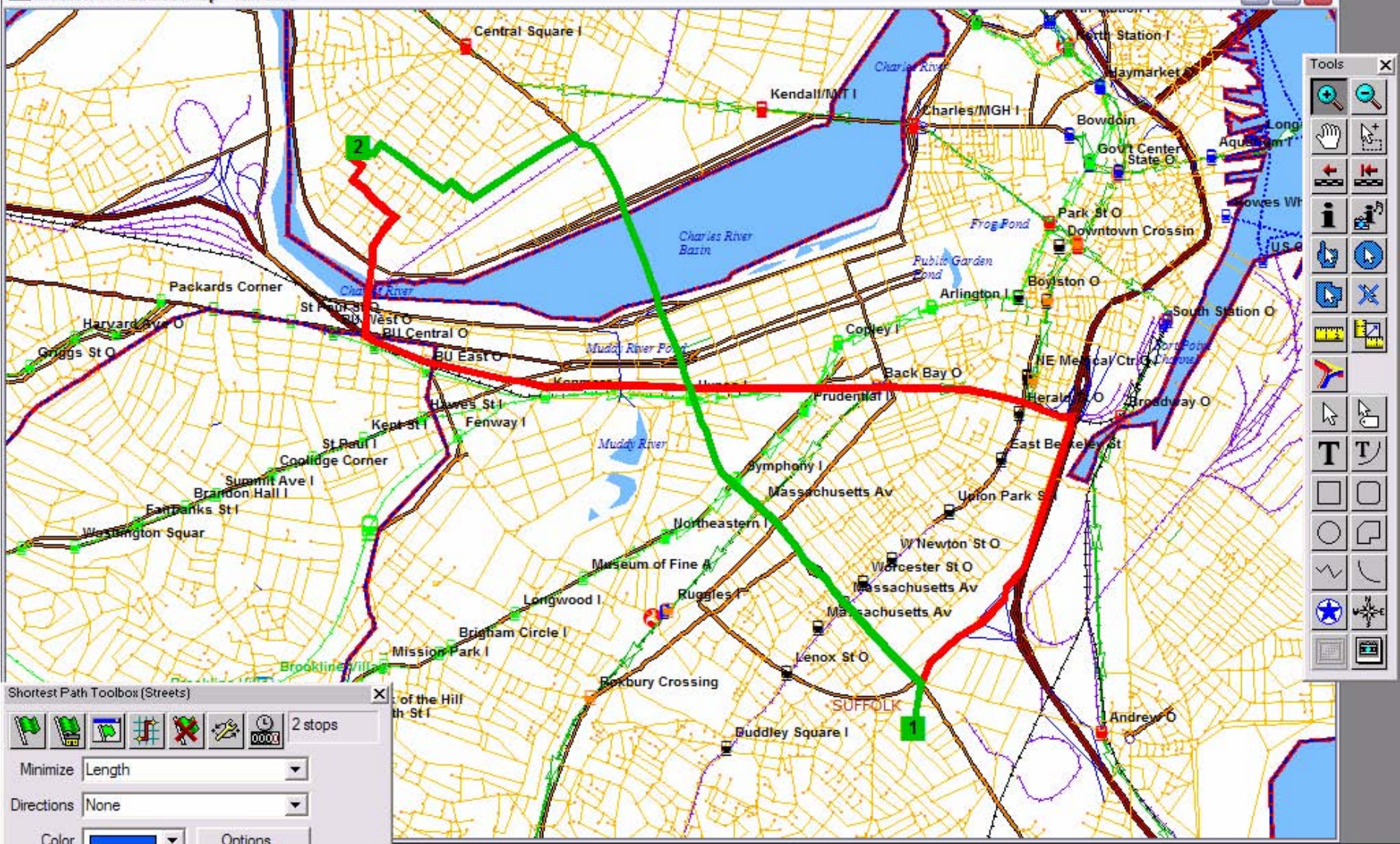




Block 1: Network Model: *Using the road*

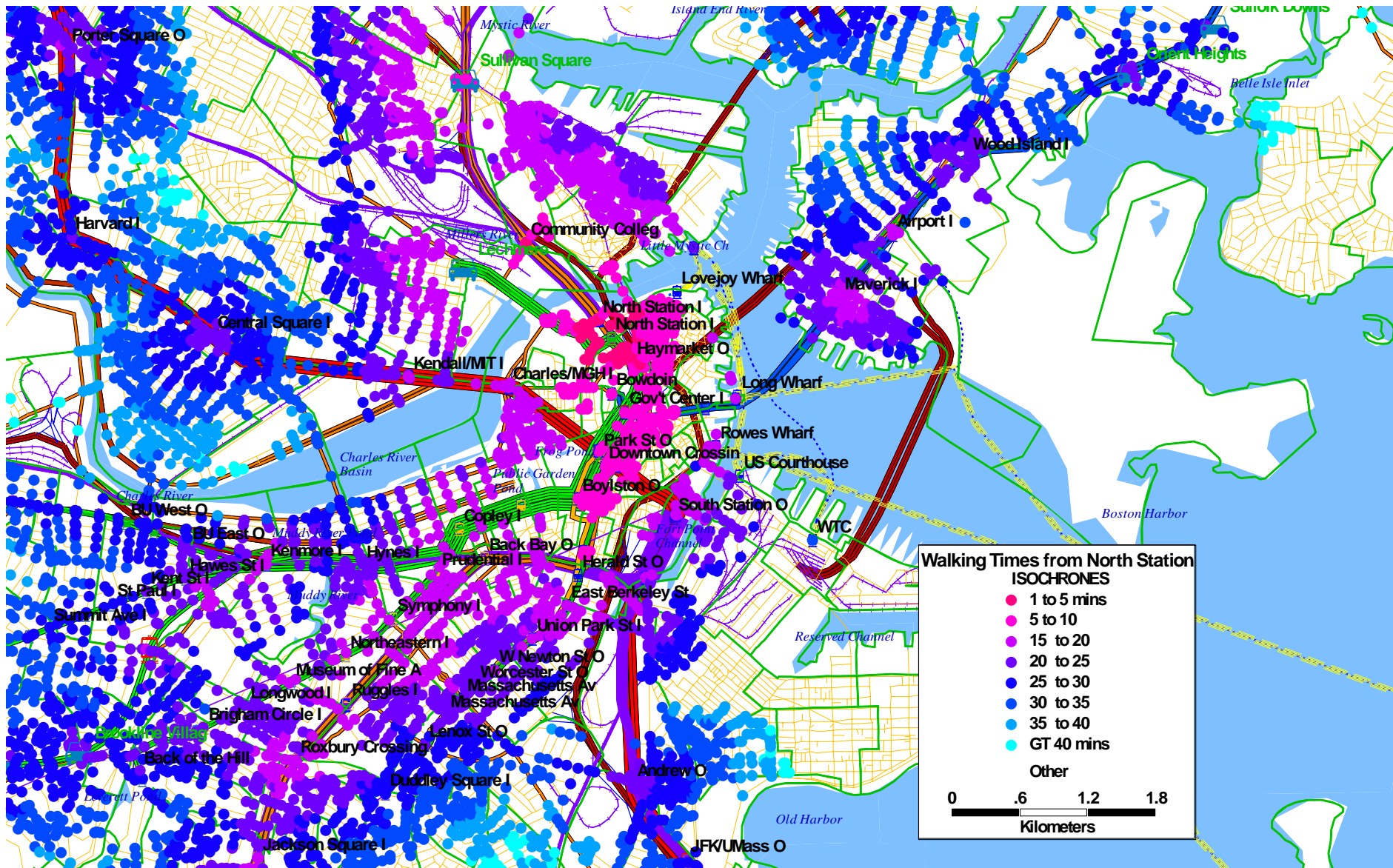
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Boston | Publico.map - Streets



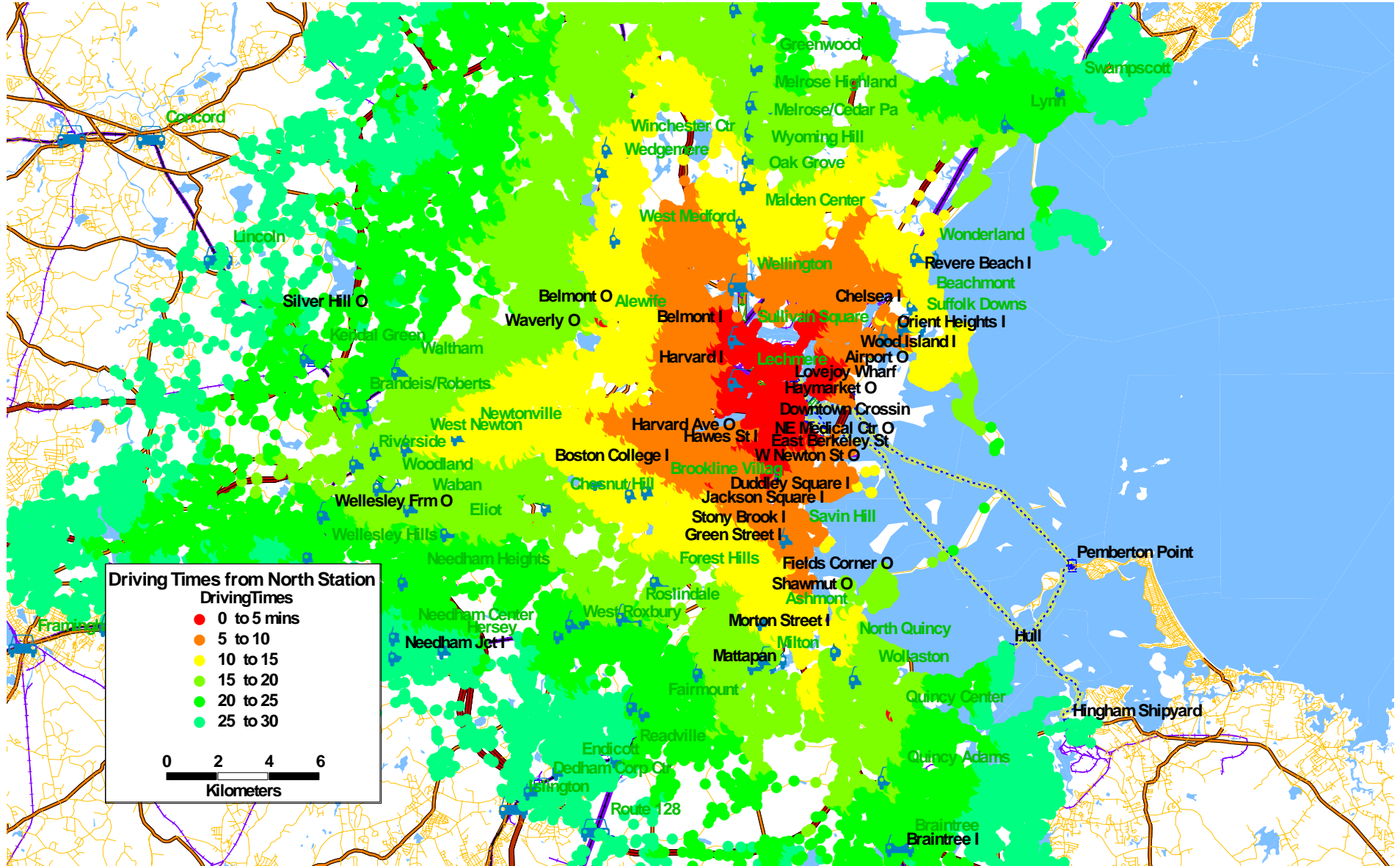
Block 1: Walking Isochrones from North Station

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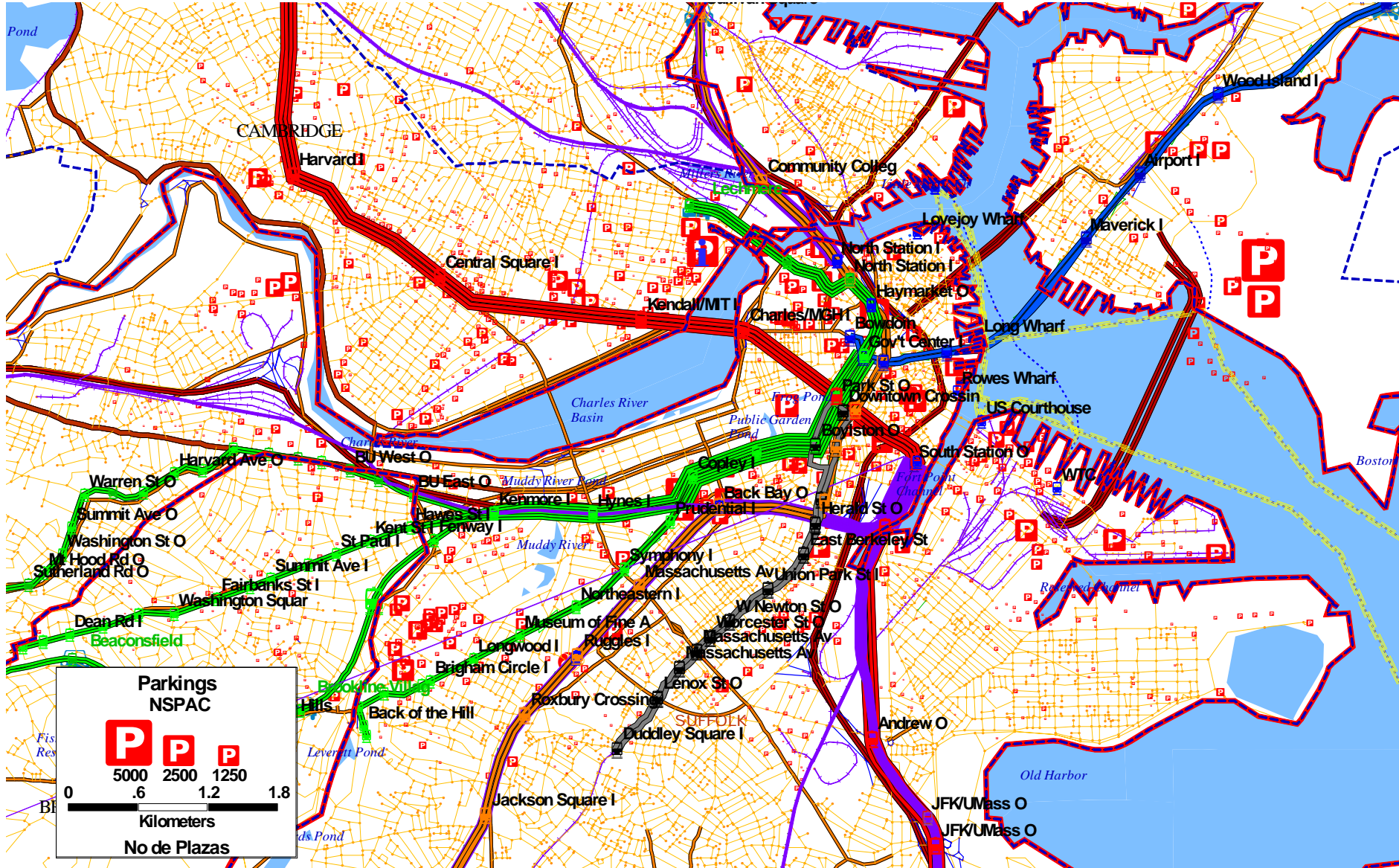
MIT Block 1: Driving Times from North Station

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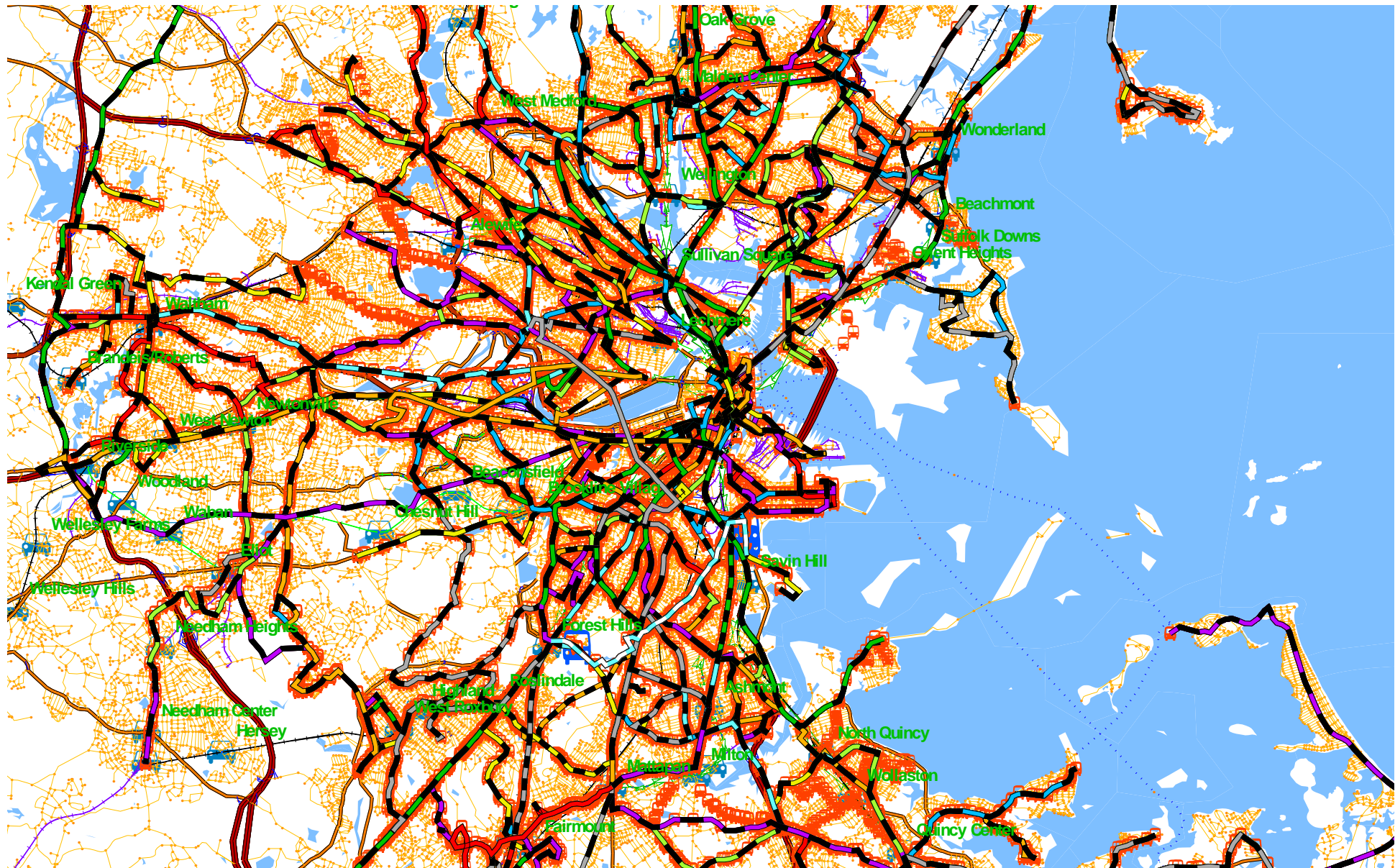
MIT Block 1: Transit and Parking Supply

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Block 1: Network Model: *The Bus system*

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Block 1: Network Model: *Using Transit*

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The screenshot shows a GIS application window titled "Boston T Publico.map - Streets". The map displays a network of transit lines in various colors (green, blue, red) and a highlighted path in blue and white dashed lines. The path starts at a node labeled "1" and ends at a node labeled "2". The map includes labels for "Community Colleg", "Lechmere", "Science Park", "Kendall/MIT", "Charles/MGH", "Frog Pond", "Public Garden Pond", "Charles River Basin", "Bowdoin", "Park St", and "Boylston".

The "Transit Path Results" window is open on the right side of the map. It contains a table of summary variables and a list of directions.

Summary Variables		Link Variable
Variable	Value	Variable
Generalized Cost	\$27.088	
Fare	\$0.000	
In-Vehicle Time	4.784(min.)	
Initial Wait Time	2.500(min.)	
Transfer Wait Time	3.500(min.)	
Transfer Penalty Time	3.000(min.)	
Transfer Walk Time	0.400(min.)	
Access Walk Time	3.024(min.)	
Egress Walk Time	7.381(min.)	
Access Drive Time	0.000(min.)	
Dwelling Time	2.500(min.)	

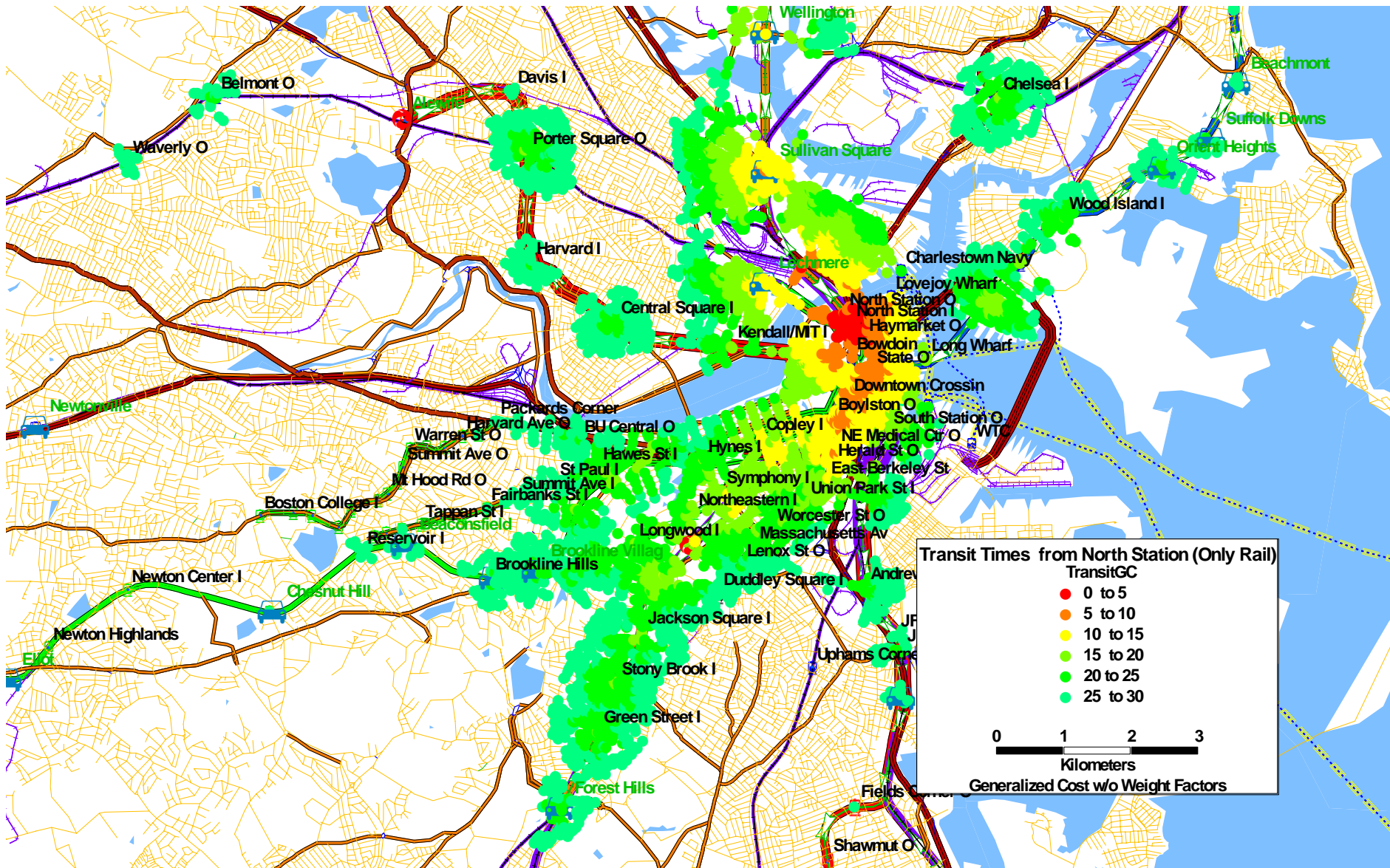
Directions:

1. Walk for 0.136 Miles.
2. Board Green B to Govt Center at for 3 stops.
Get off at .
3. Walk for 0.043 Miles.
4. Board Red Line Braintree to Alewife at for 2 stops.
Get off at .
5. Walk for 0.353 Miles.

At the bottom left, there is a "Transit Shortest Path Toolbox" with icons for path selection, color selection, and multiple nodes. The color is set to blue.

MIT Block 1: Transit Times from North Station

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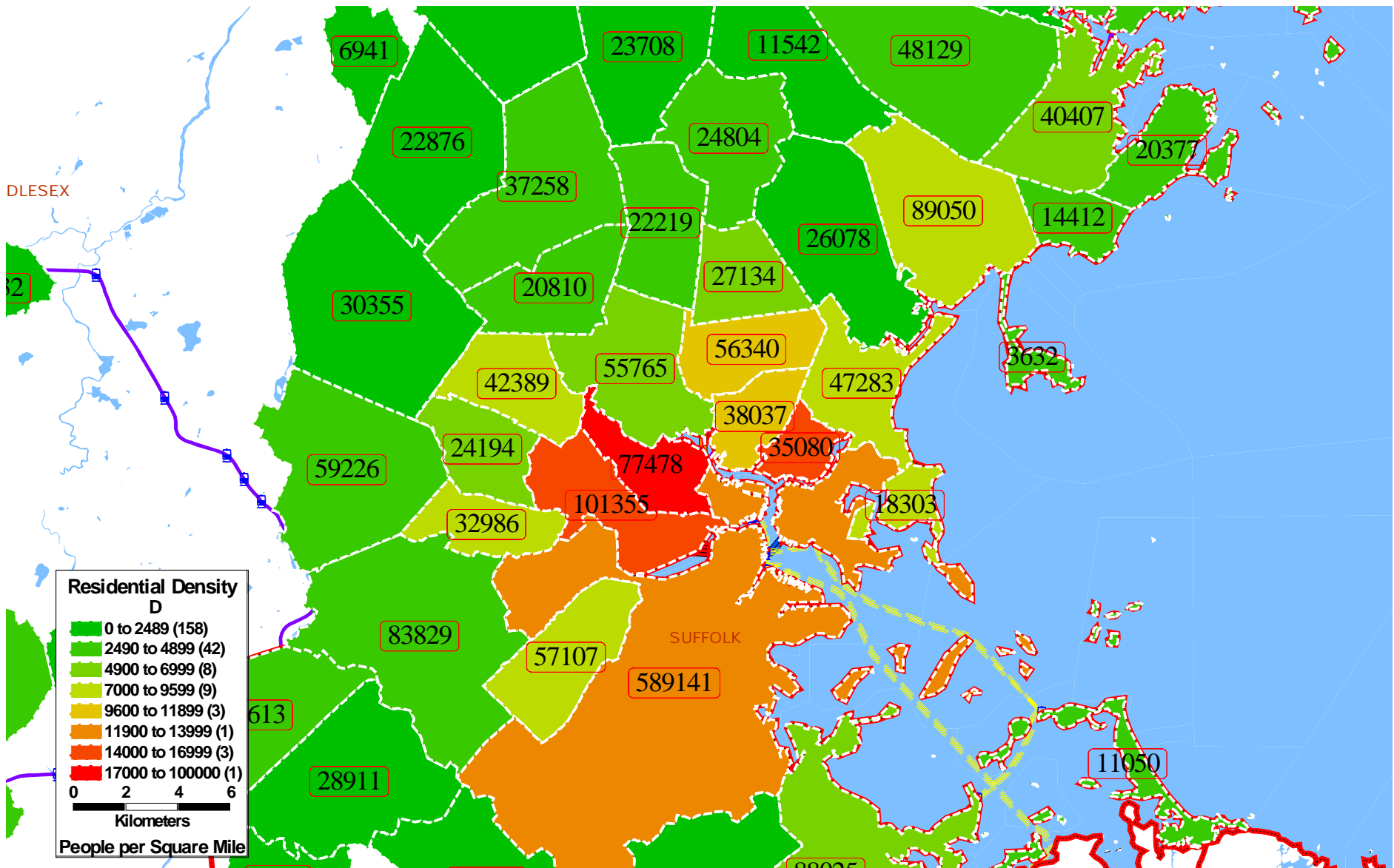
Block 2: *Data, data, data...*

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- What do you know about the area beyond a quick 3-D tour with Google Earth?
- What is the density of residences?
- What about jobs?
- Have you checked the Census data?
- Do they have lots of parking?

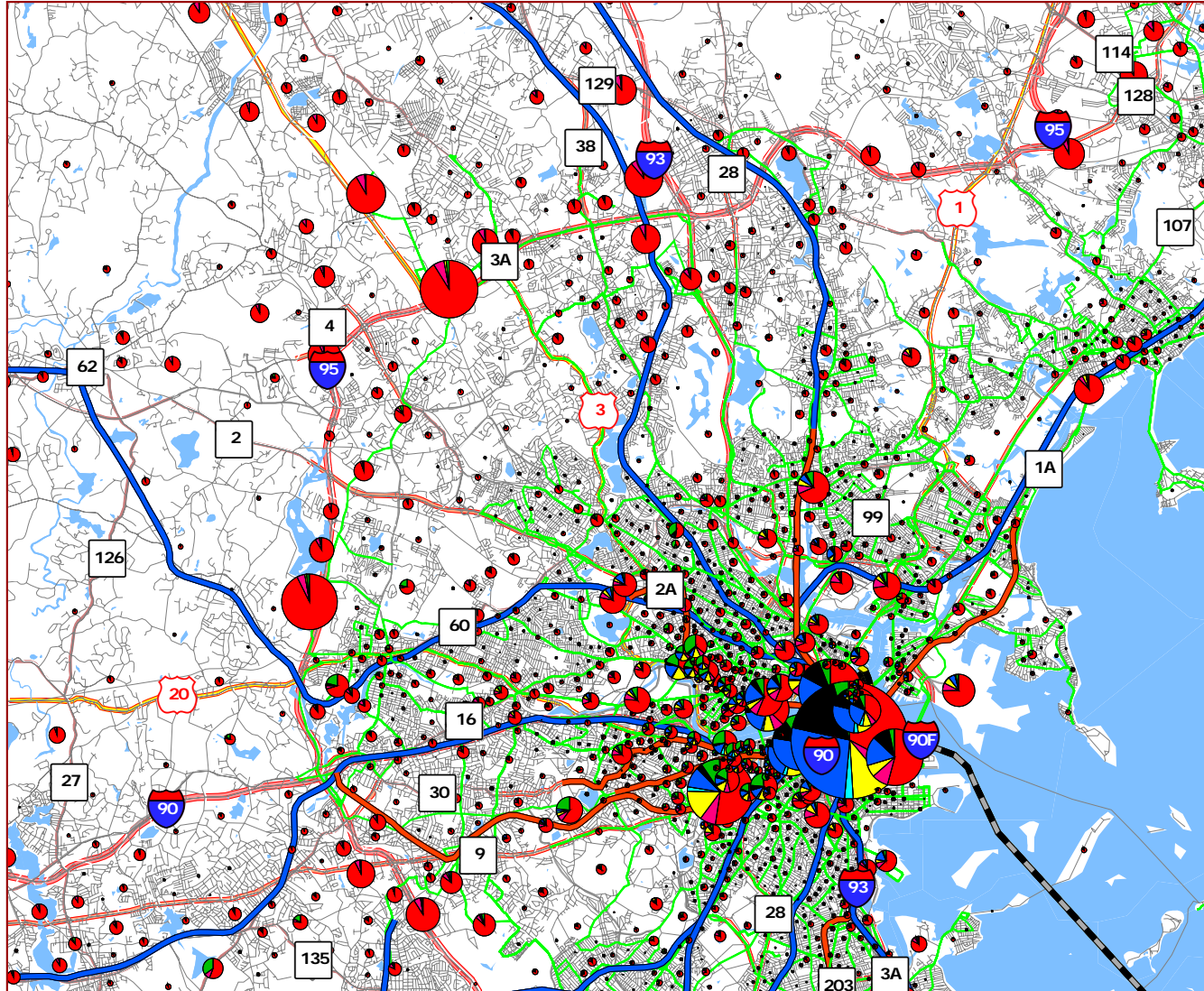
Block 2: Residential Density

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Block 2: Distribution of jobs, hospitals, airports, etc.

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Block 3: Behavioral Patterns

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- How many trips per person per day?
- Which are the most important trip purposes?
- How do they vary along the day?
- Why some people choose transit?
- Why others are captive to the car?
- How do they react to price increases of transit fares, parking, tolls...?