Practical Uses of Big Transportation Data for Cities and Municipalities

Penn State

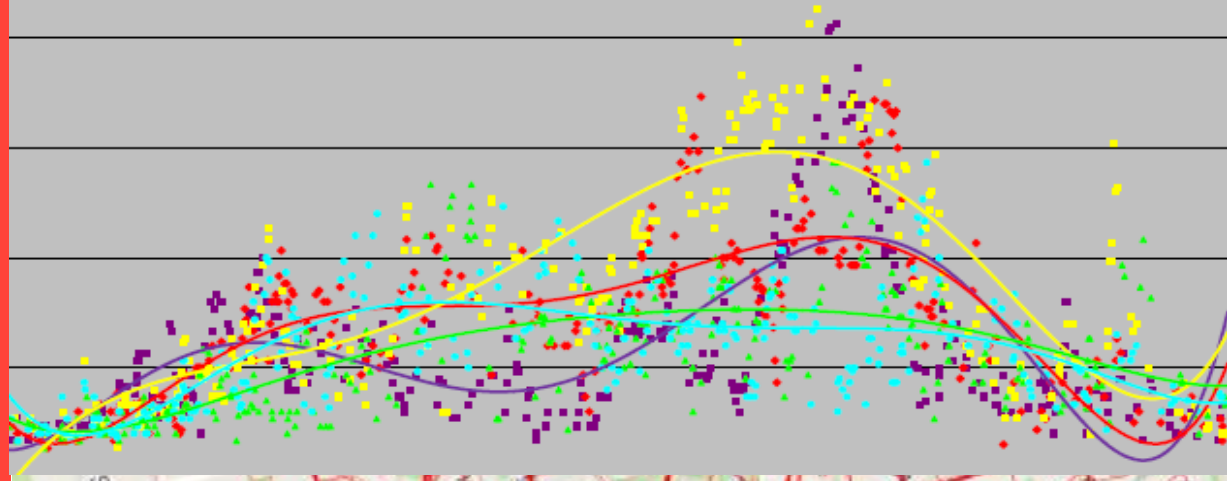
Traffic Engineering and Safety Conference

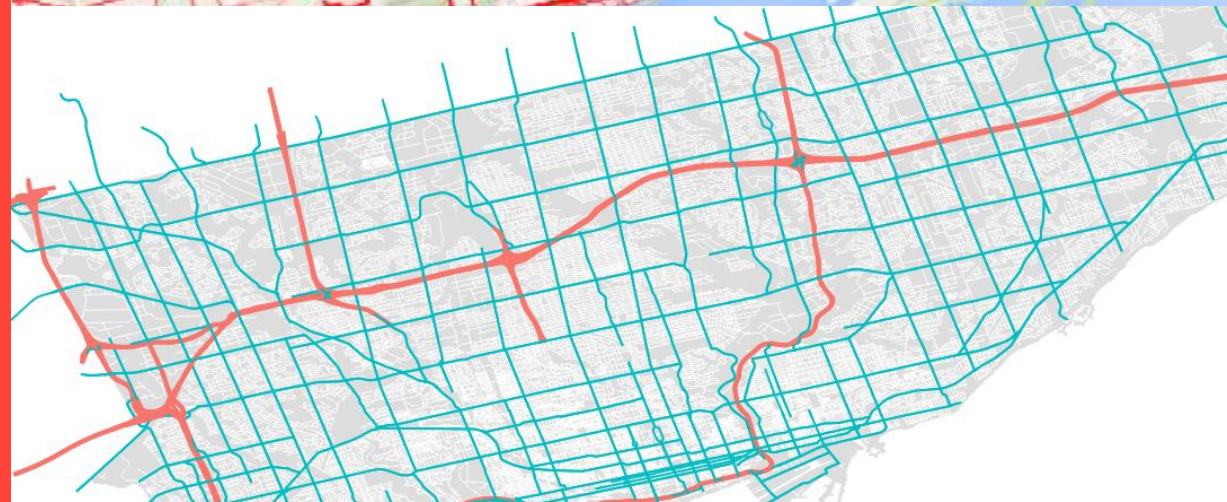
Stephen Buckley, P.E., AICP

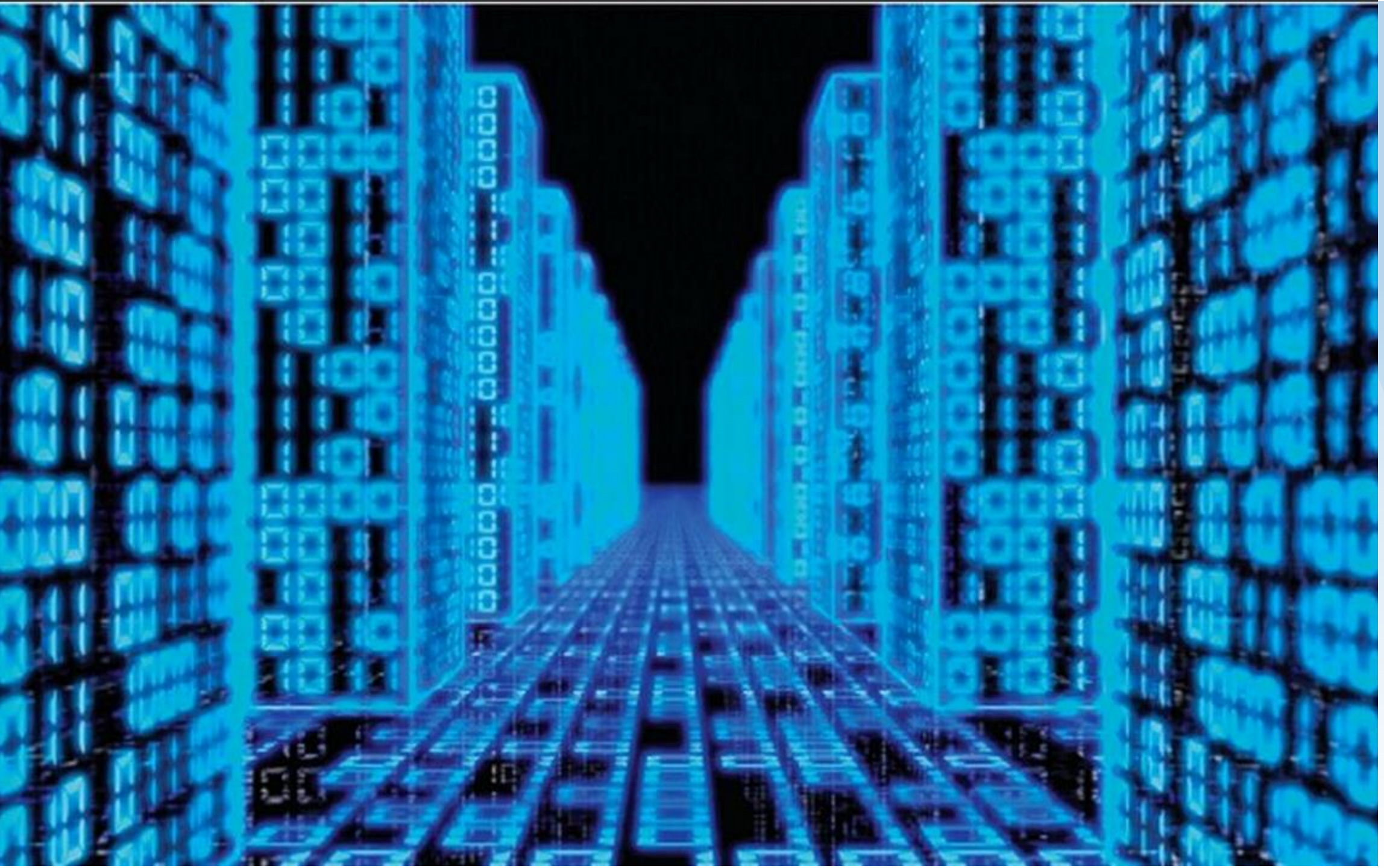
Northeast Regional Manager
for Planning, Environment and Traffic

WSP

December 6, 2018



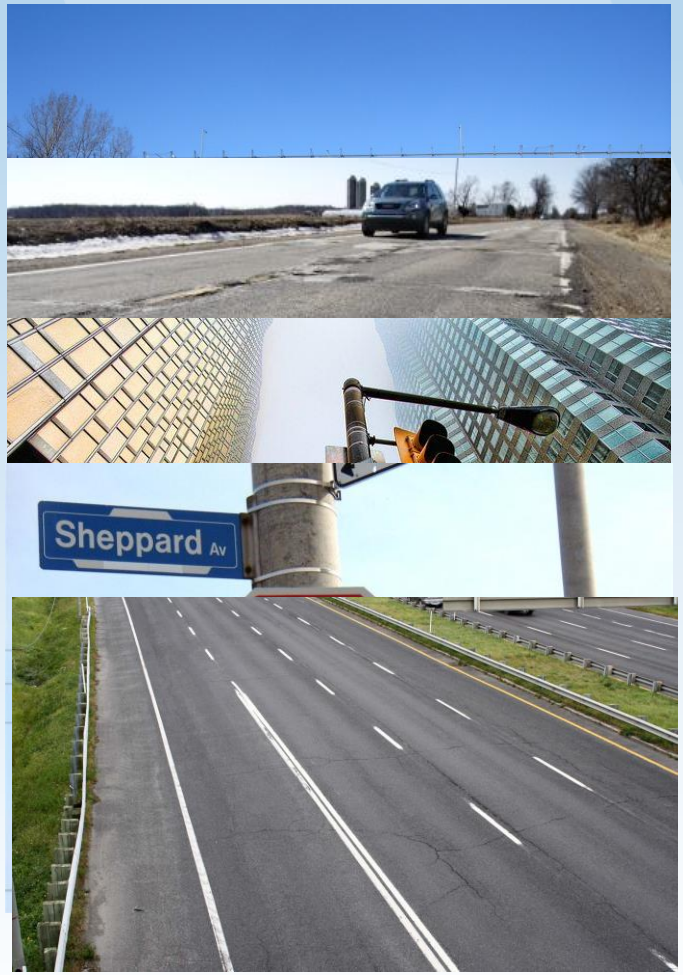




Practical Uses of Big Data in Transportation

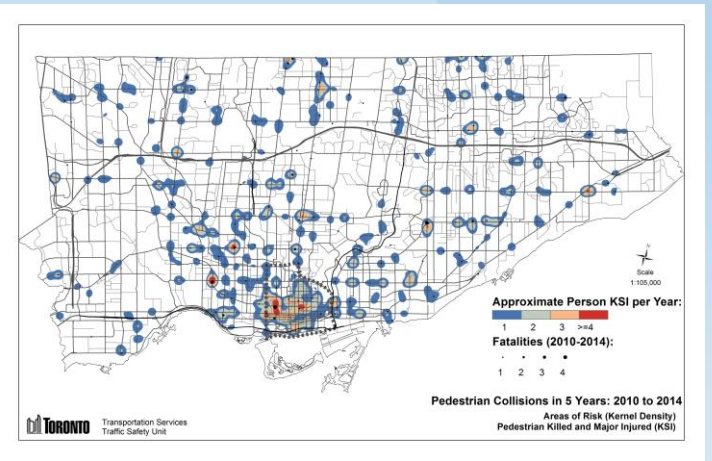
Data in Transportation

Asset Management



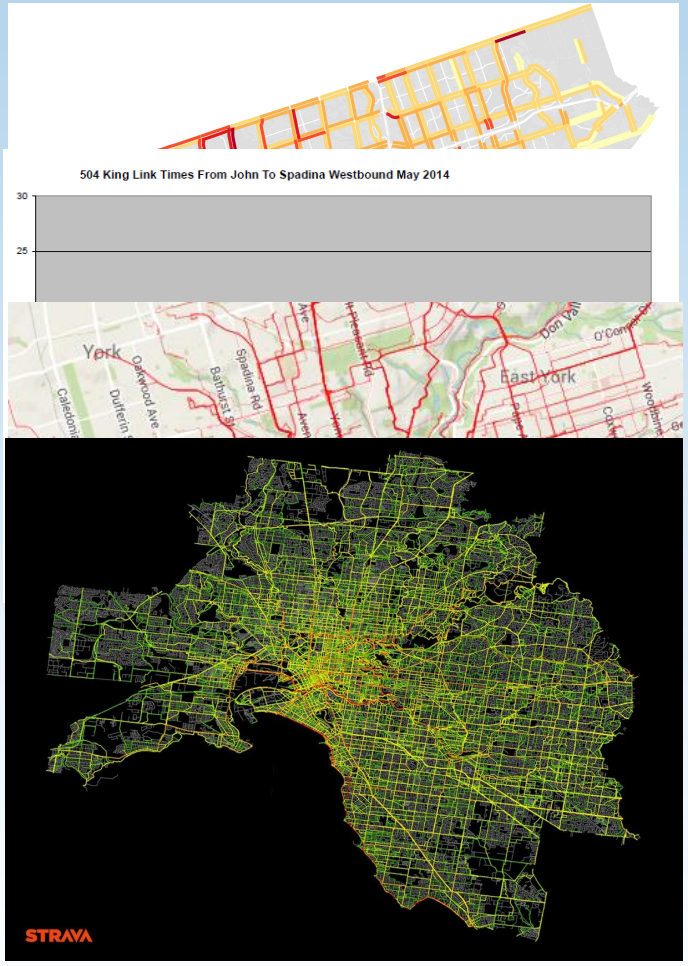
Mobility

Safety

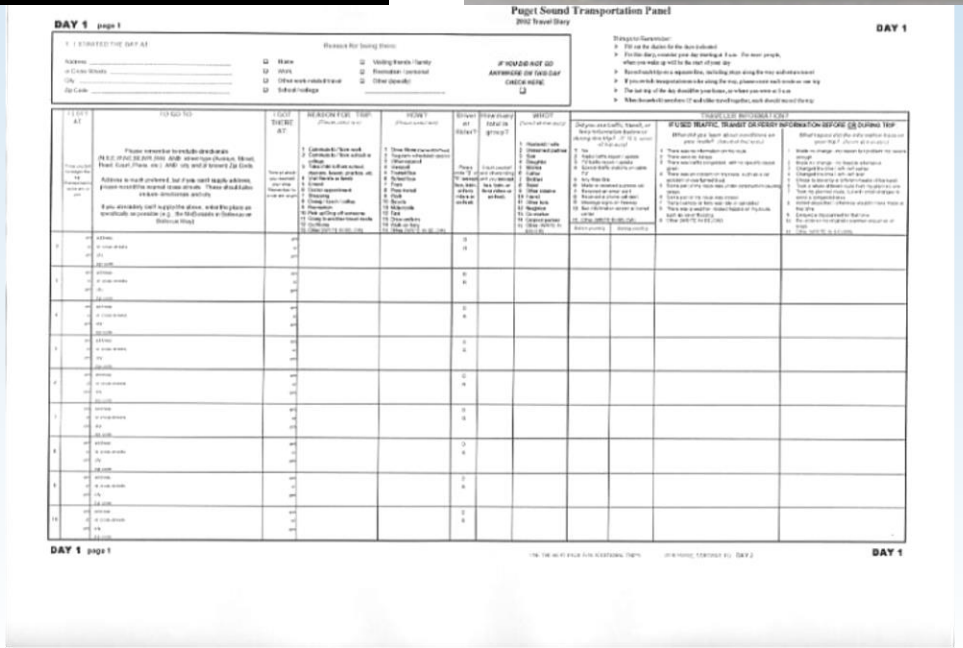


Data in Transportation

Mobility

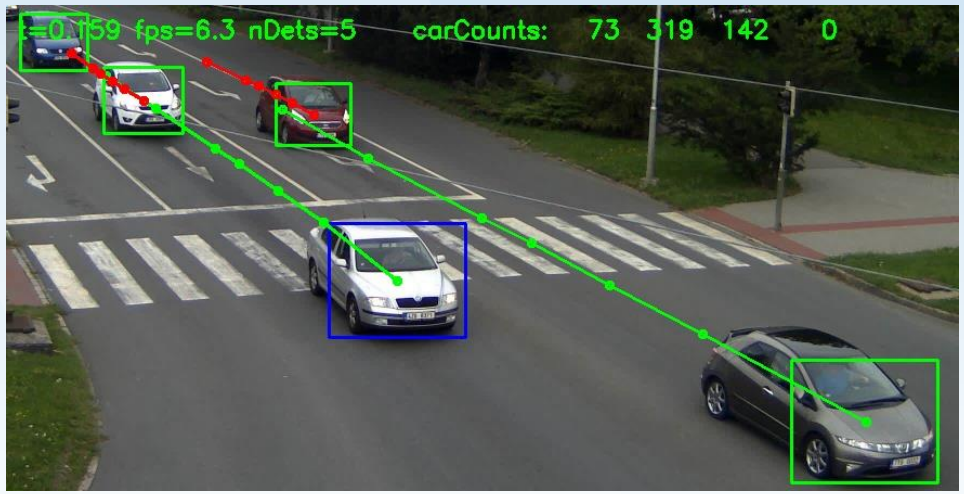


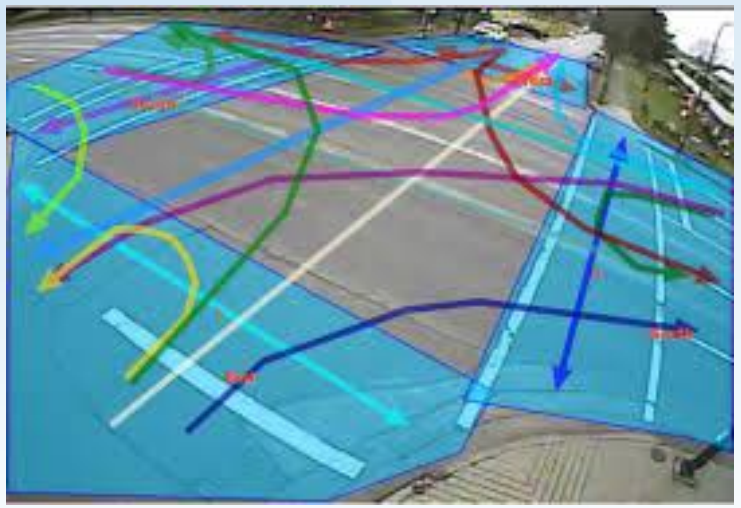
Transportation Data Collection



Traffic Data Collection

Traffic Data Collection





Travel Data


I-95 Vehicle Probe Project
I-95 CORRIDOR
COALITION
511
here
INRIX

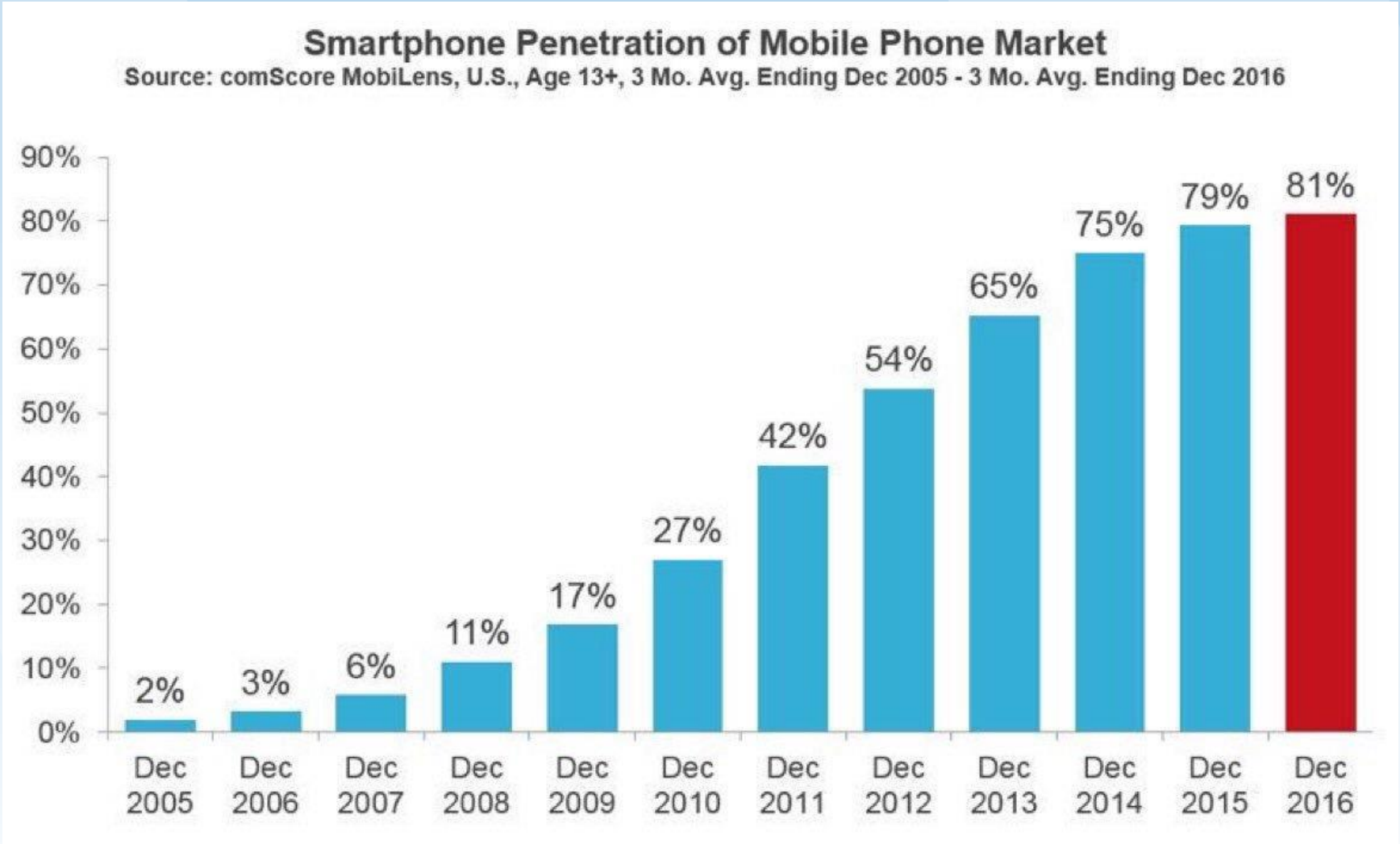
So What Has Changed?

So What Has Changed?

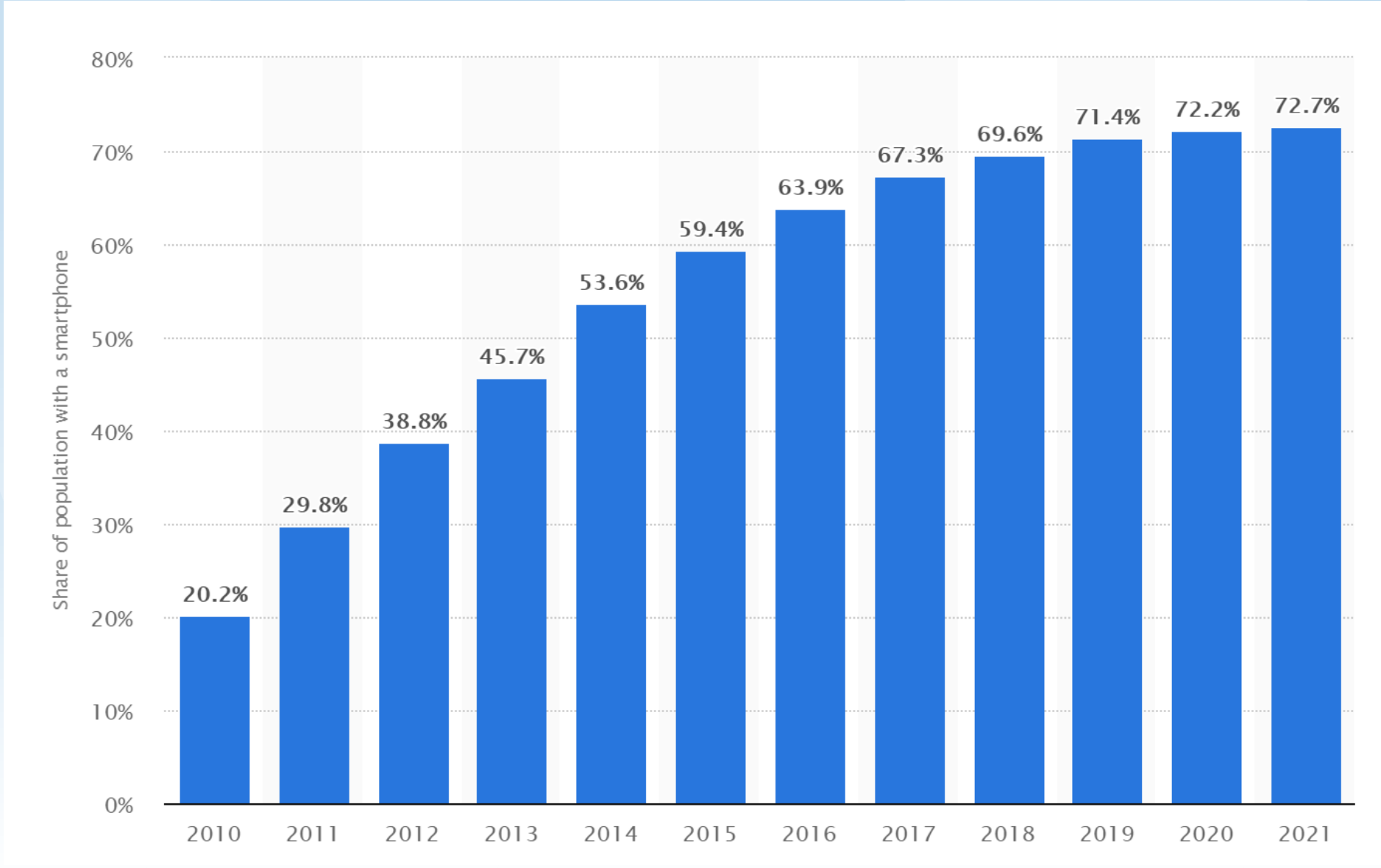
So What Has Changed?

So What Has Changed?

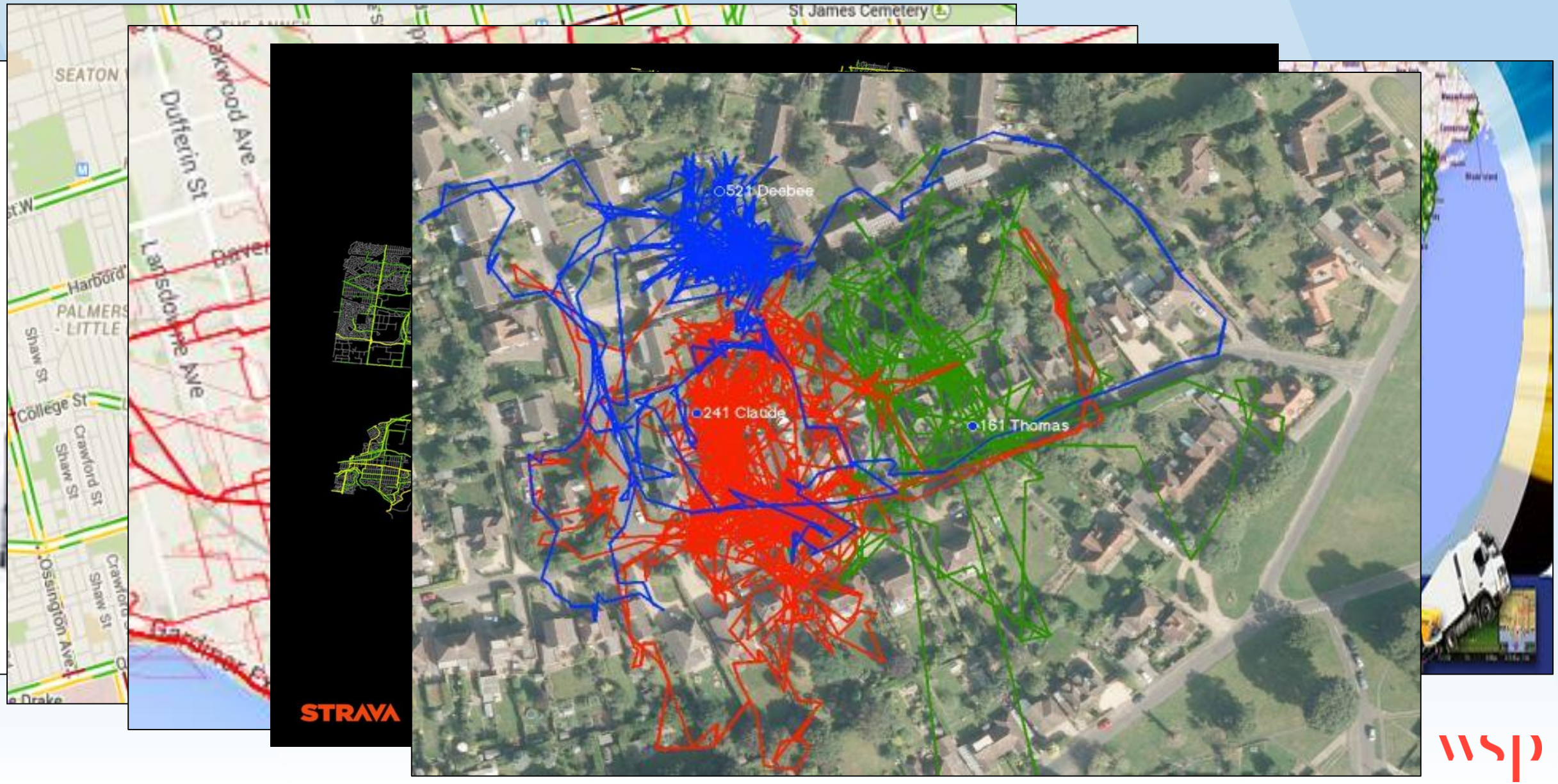
So What Has Changed?



So What Has Changed?



Travel Data


St James Cemetery
SEATON
Dufferin St
Oakwood Ave
Lansdowne Ave
Harbord
PALMERS
- LITTLE
Shaw St
College St
Crawford St
Ossington Ave
STRAVA
521 Deebee
241 Claude
161 Thomas

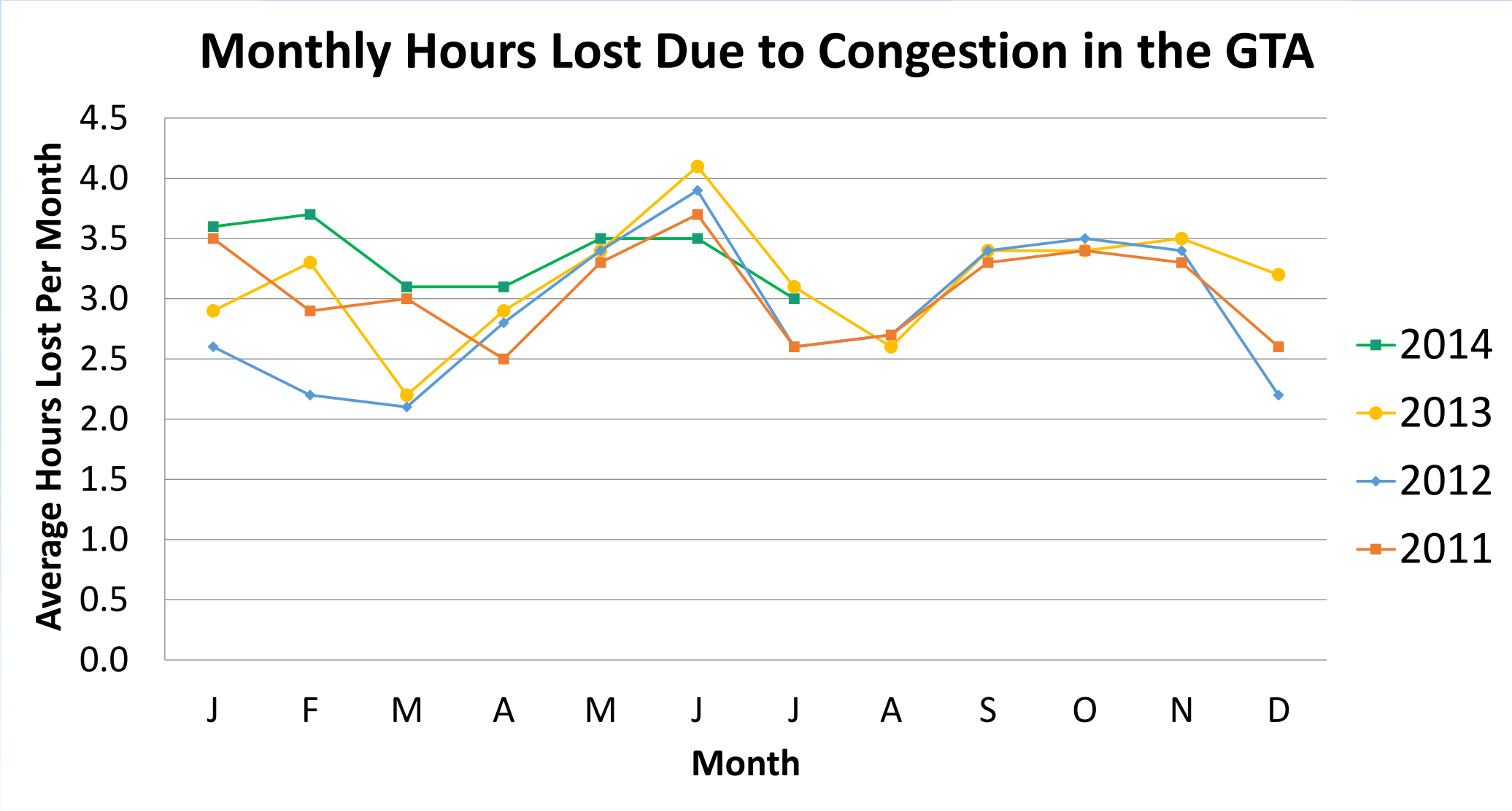
So How Can We Use Big Transportation Data?

How We Can Use Big Transportation Data?

Describing	• Understanding what is happening
Evaluating	• Measuring changes
Operating	• Identifying issues real-time
Planning	• Modelling
Predicting	• Proactively communicating trip info

Describing

Changes in Congestion



Source: Inrix

Toronto ranked last in survey of commuting times

-Toronto Star, March 29, 2010

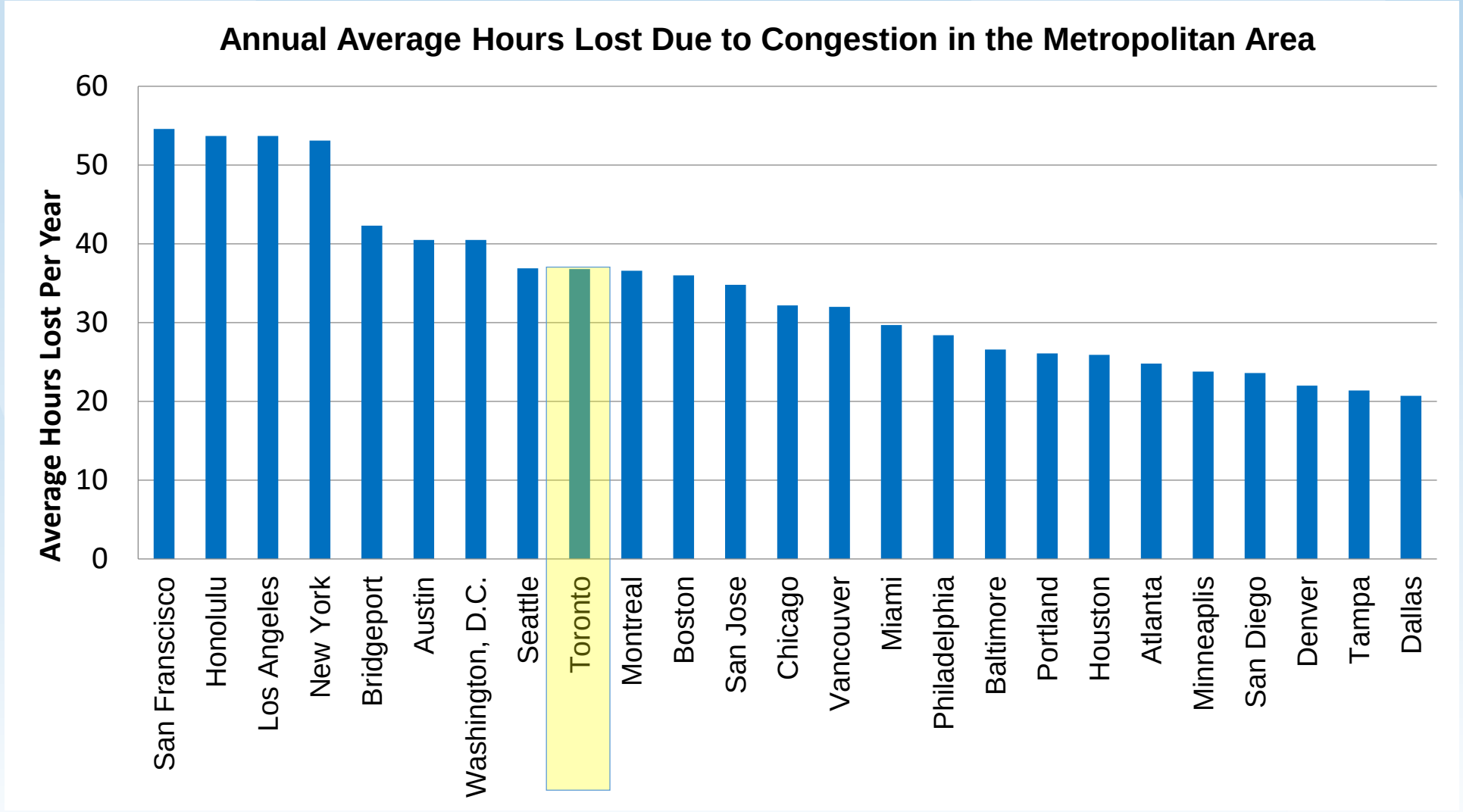
Gridlock a grind on Toronto's economy: report

- CBC News, June 28, 2011

Congestion cost may be up to $11 billion for GTA, study says

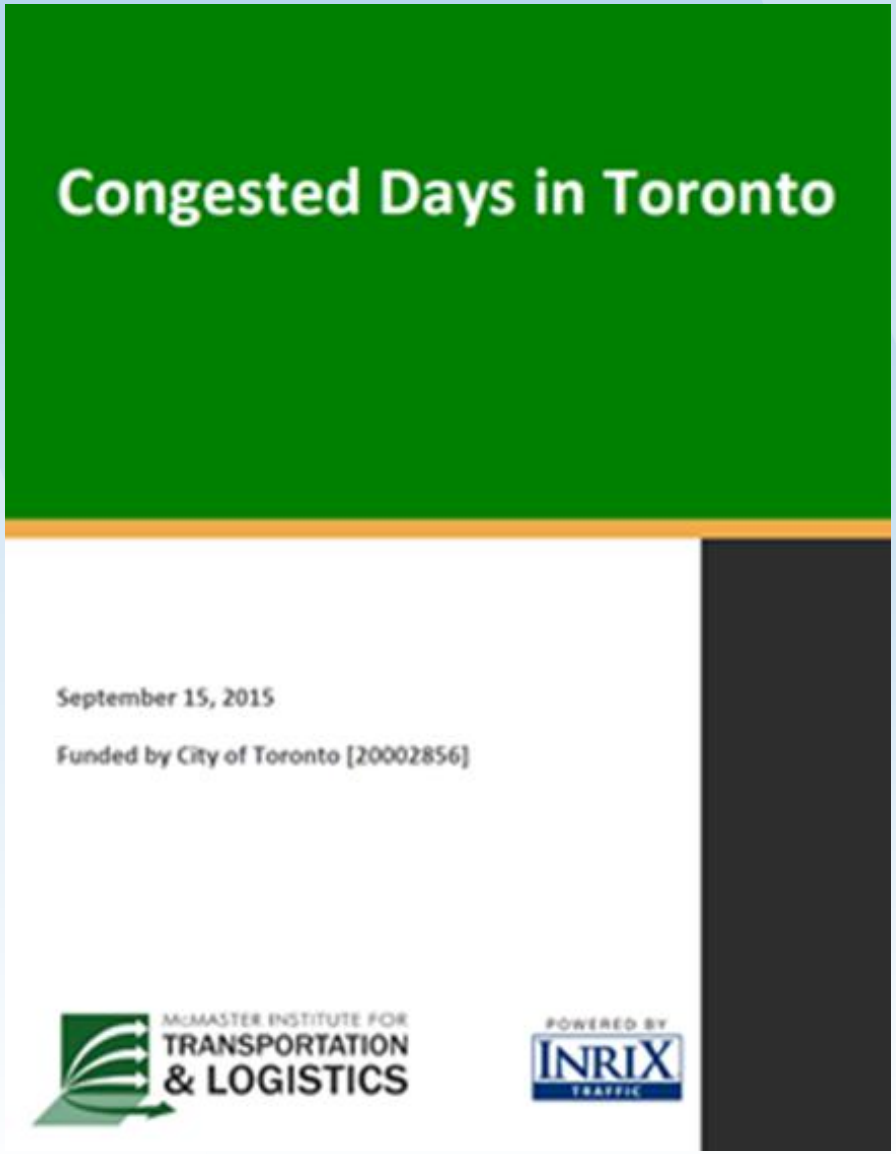
- Toronto Star, July 11, 2013

How Does Toronto Stack Up?

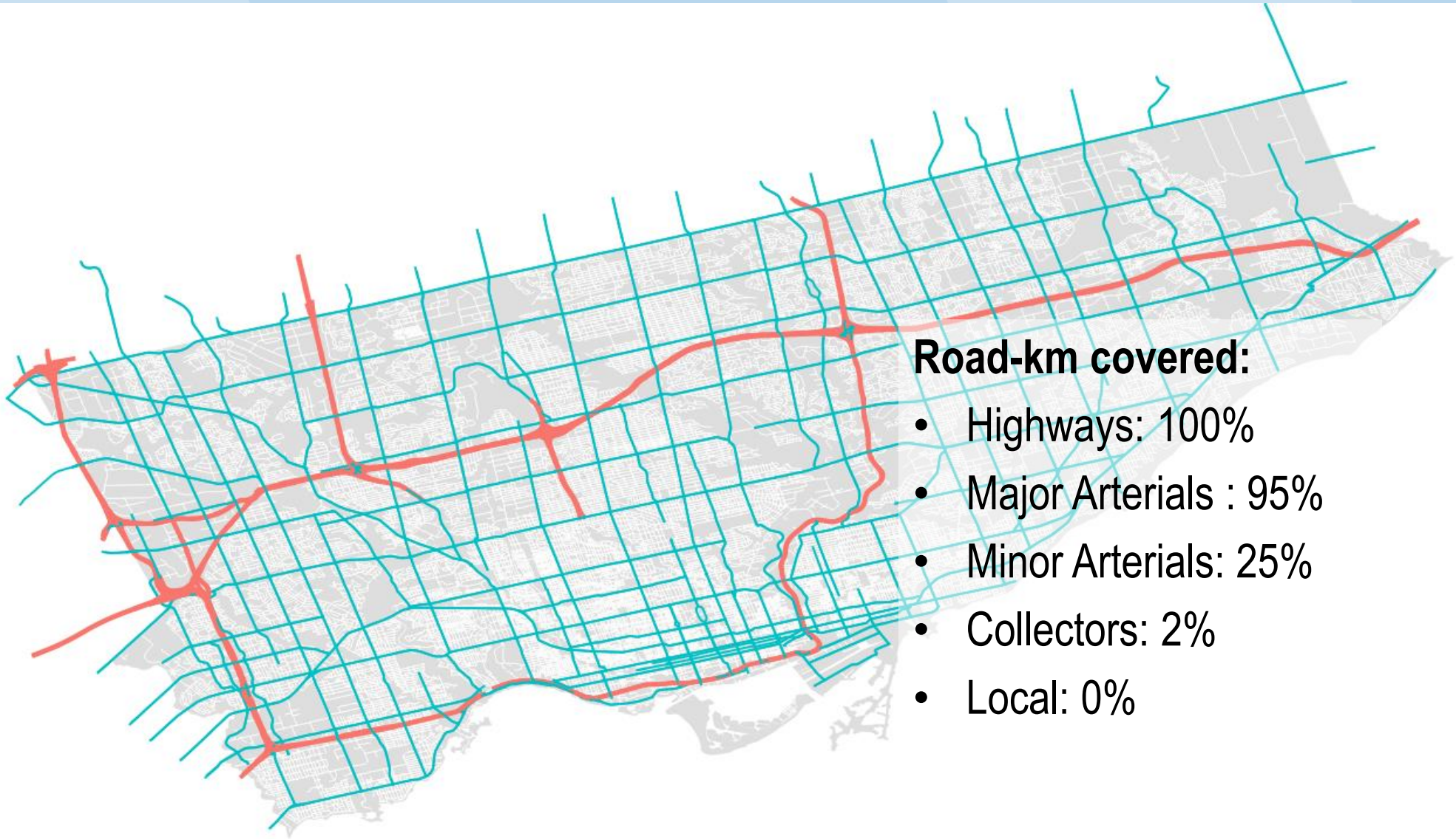


Source: Inrix

McMaster University Research



Study Coverage

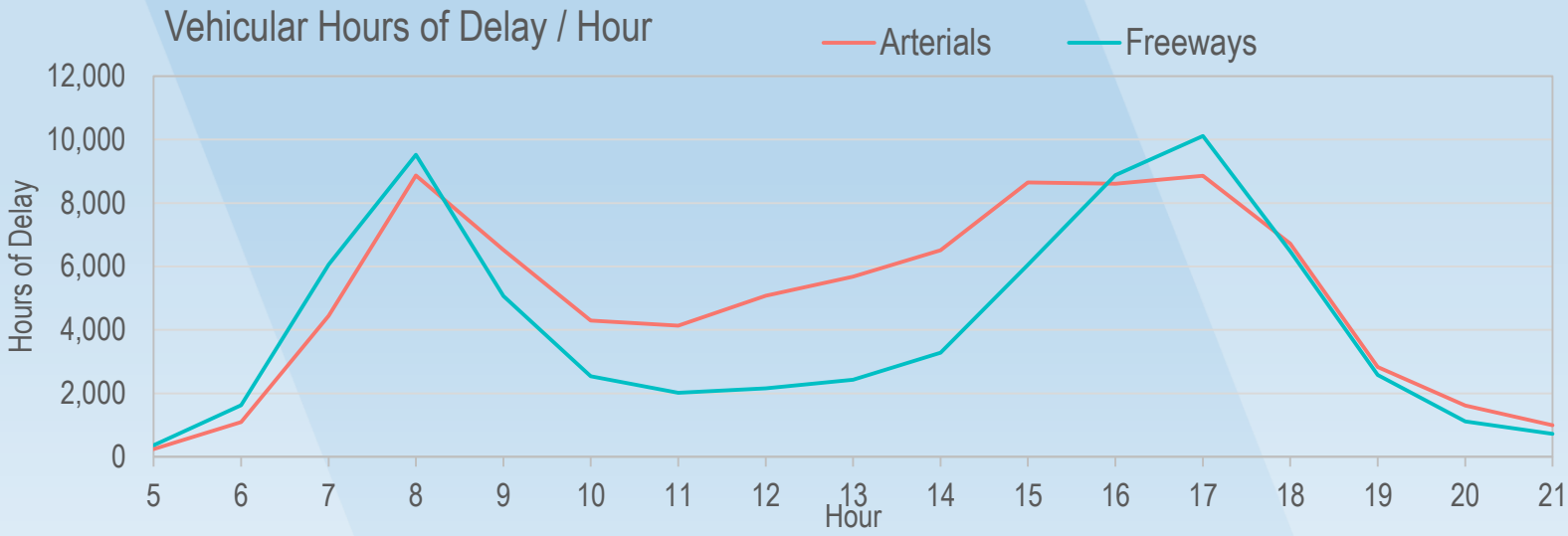


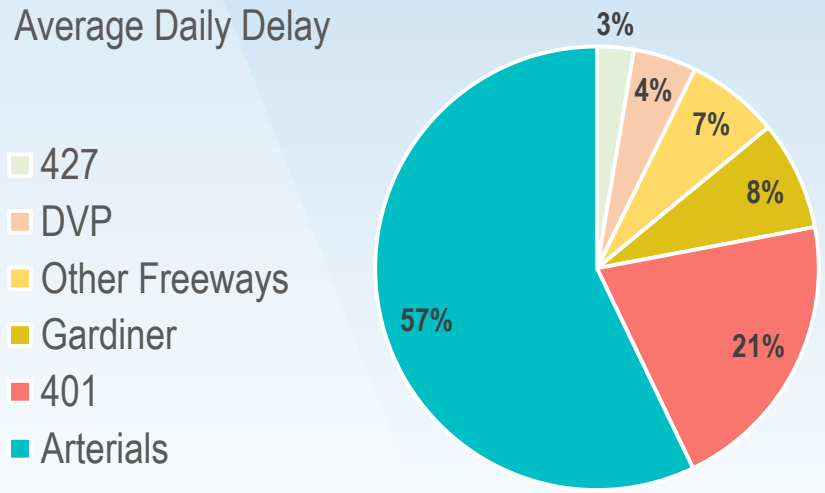
Road-km covered:

- Highways: 100%
- Major Arterials : 95%
- Minor Arterials: 25%
- Collectors: 2%
- Local: 0%

Data Companies

Where and When is Delay Occurring?





BEST/WORST CONGESTED DAYS (all days)

- 10 SLOWEST DAYS
- NEXT 20 SLOWEST DAYS
- 10 FASTEST DAYS
- NEXT 20 FASTEST DAYS

January

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

March

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

April

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

May

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

June

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

July

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

August

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

September

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

October

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

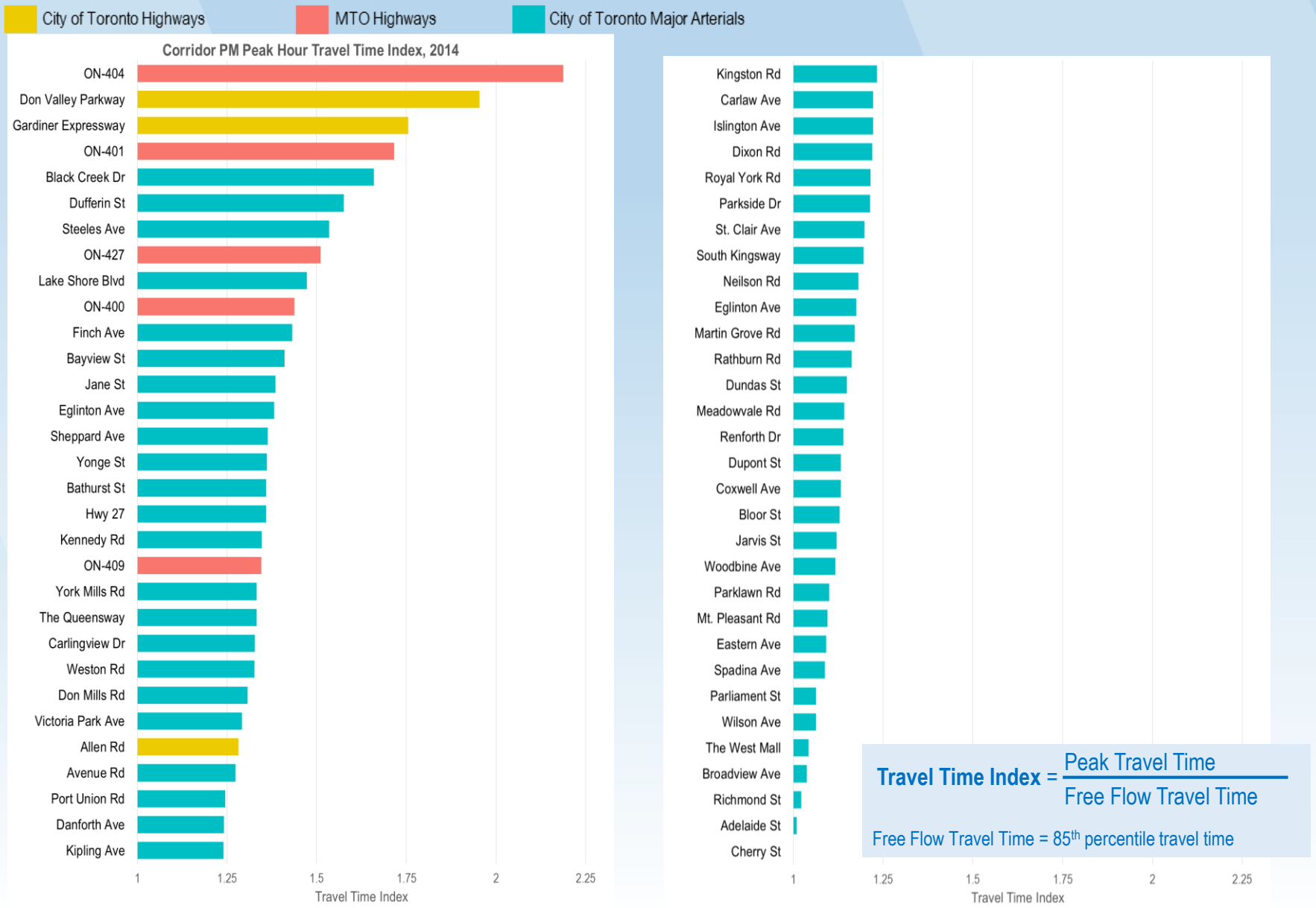
November

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

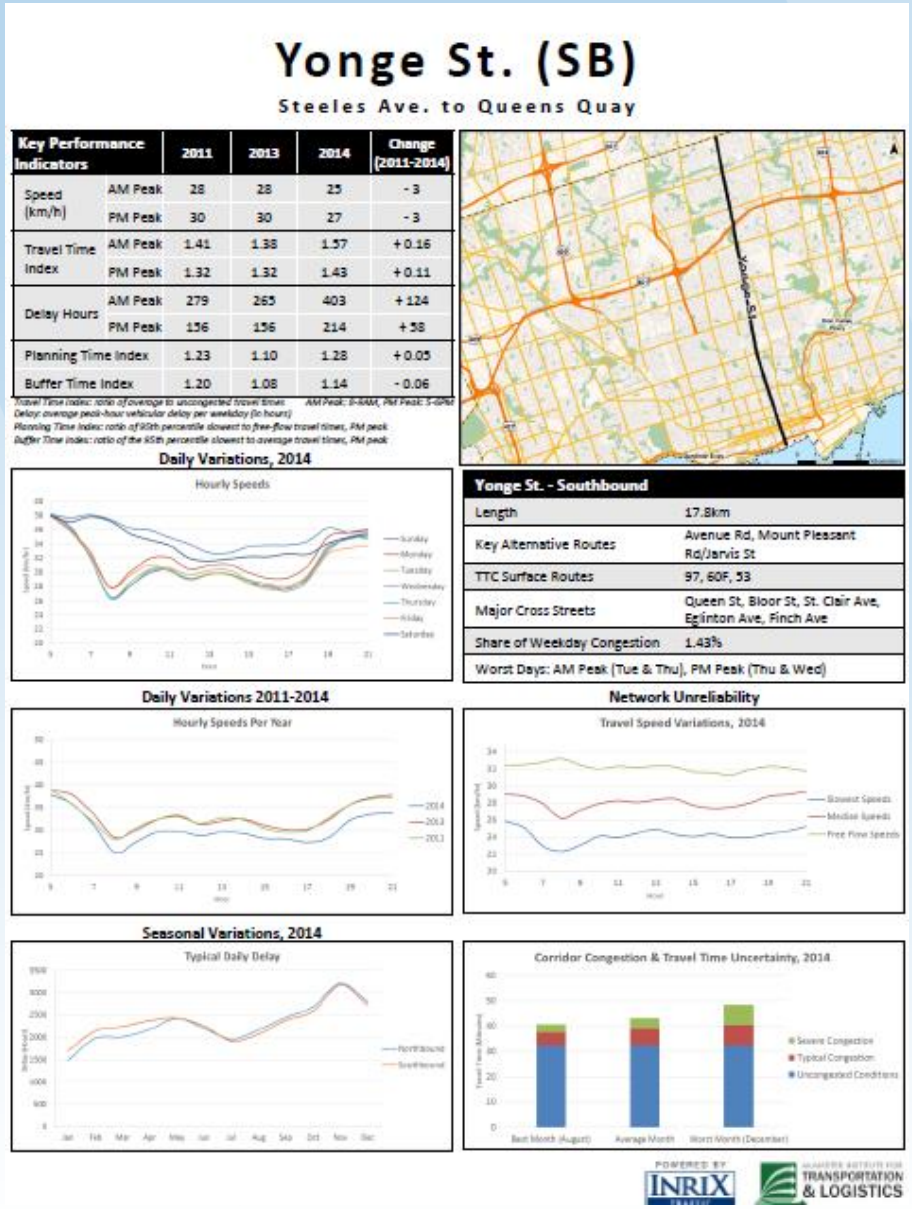
December

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Quantifying Congestion



Corridor Report Cards



Yonge St. (SB)

Steeles Ave. to Queens Quay

Key Performance Indicators		2011	2013	2014	Change (2011-2014)
Speed (km/h)	AM Peak	28	28	25	- 3
	PM Peak	30	30	27	- 3
Travel Time Index	AM Peak	1.41	1.38	1.57	+ 0.16
	PM Peak	1.32	1.32	1.43	+ 0.11
Delay Hours	AM Peak	279	265	403	+ 124
	PM Peak	156	156	214	+ 58
Planning Time Index		1.23	1.10	1.28	+ 0.05
Buffer Time Index		1.20	1.08	1.14	- 0.06

Travel Time Index: ratio of average to uncongested travel times AM Peak: 8-9AM, PM Peak: 5-6PM
Delay: average peak-hour vehicular delay per weekday (in hours)
Planning Time Index: ratio of 95th percentile slowest to free-flow travel times, PM peak
Buffer Time Index: ratio of the 95th percentile slowest to average travel times, PM peak

Daily Variations, 2014

Yonge St. - Southbound	
Length	17.8km
Key Alternative Routes	Avenue Rd, Mount Pleasant Rd/Jarvis St
TTC Surface Routes	97, 60F, 53
Major Cross Streets	Queen St, Bloor St, St. Clair Ave, Eglinton Ave, Finch Ave
Share of Weekday Congestion	1.43%
Worst Days: AM Peak (Tue & Thu), PM Peak (Thu & Wed)	

Daily Variations 2011-2014

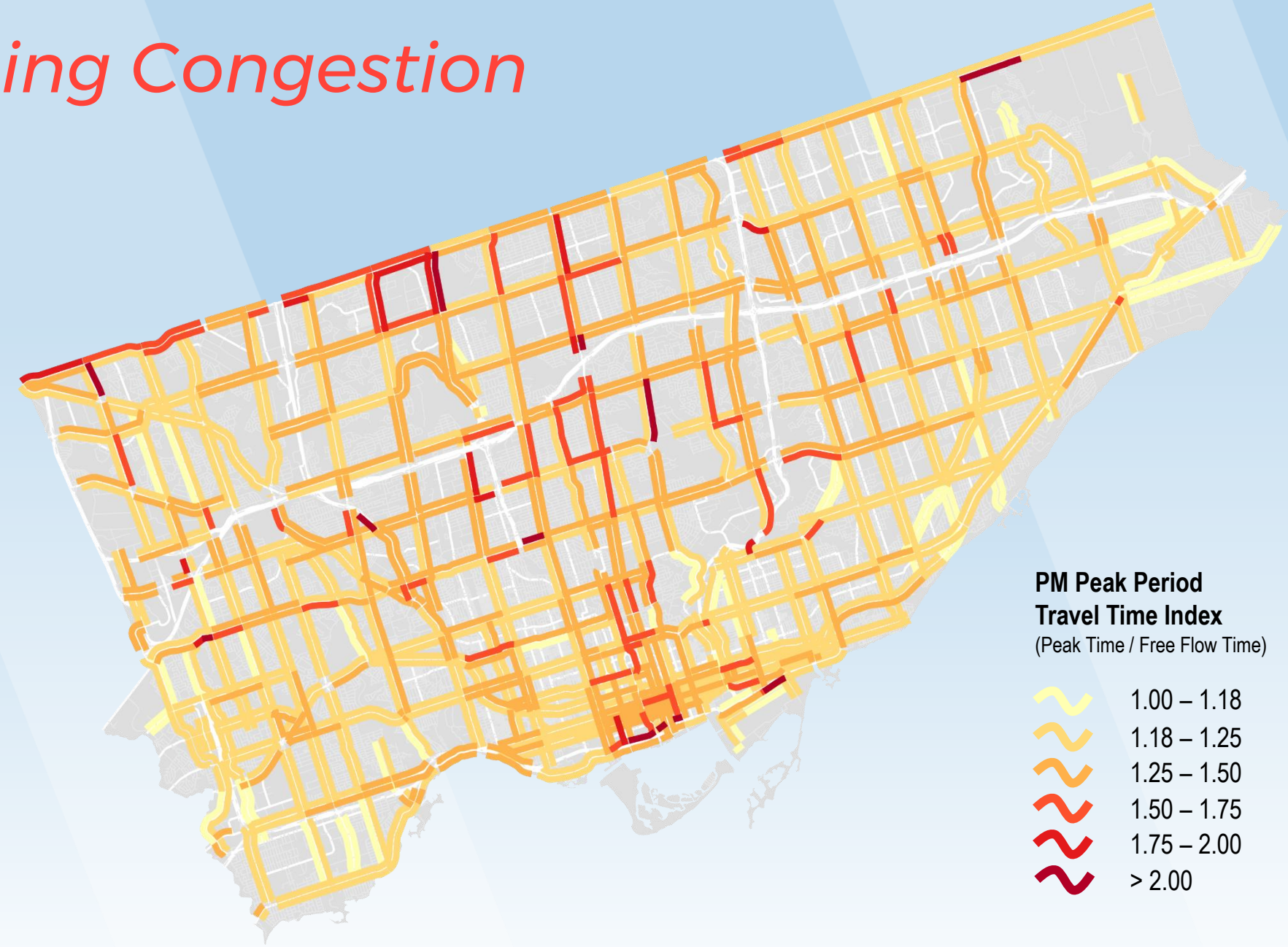
Network Unreliability

Seasonal Variations, 2014

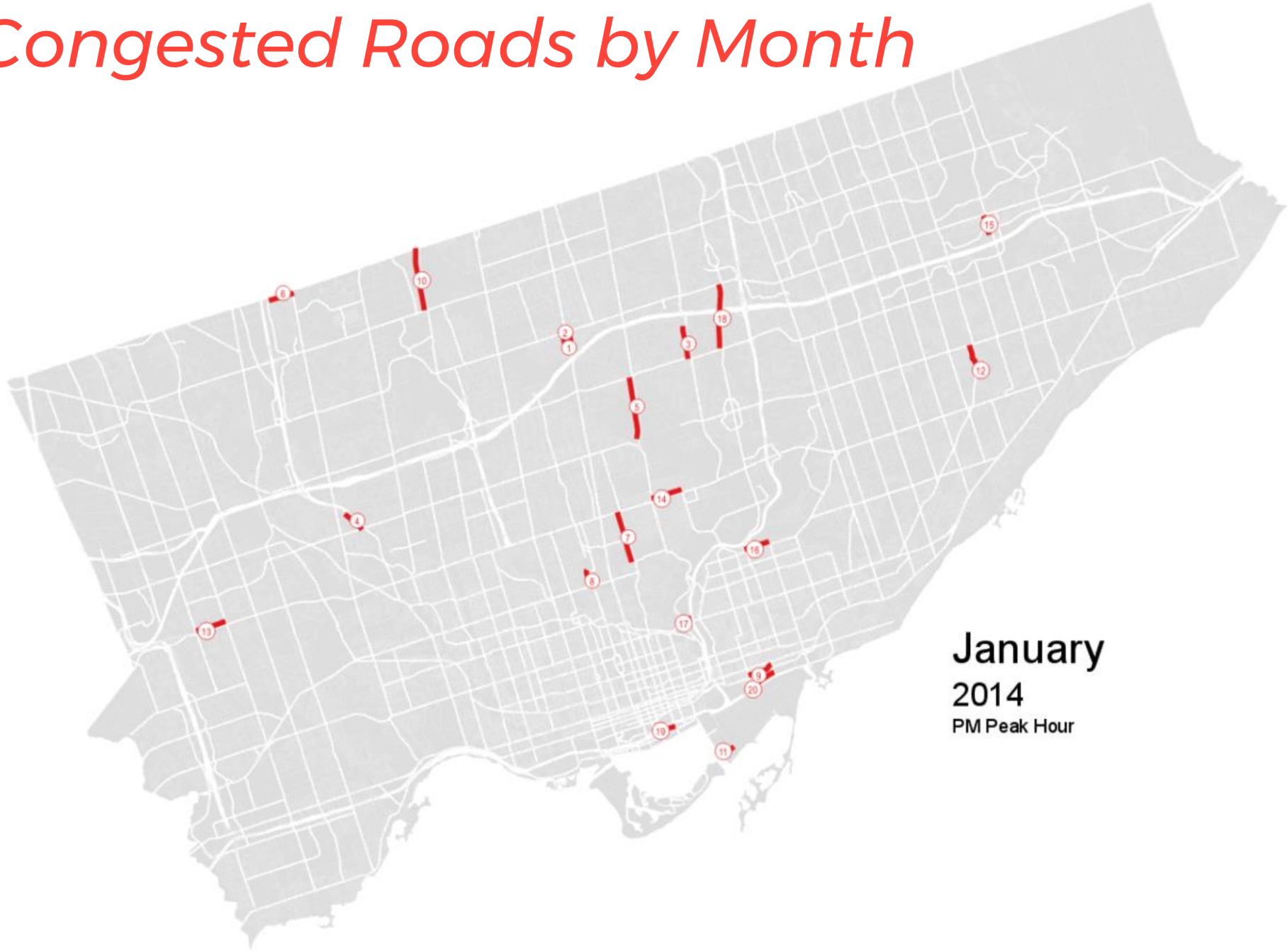
POWERED BY INRIX

TRANSPORTATION & LOGISTICS

Mapping Congestion

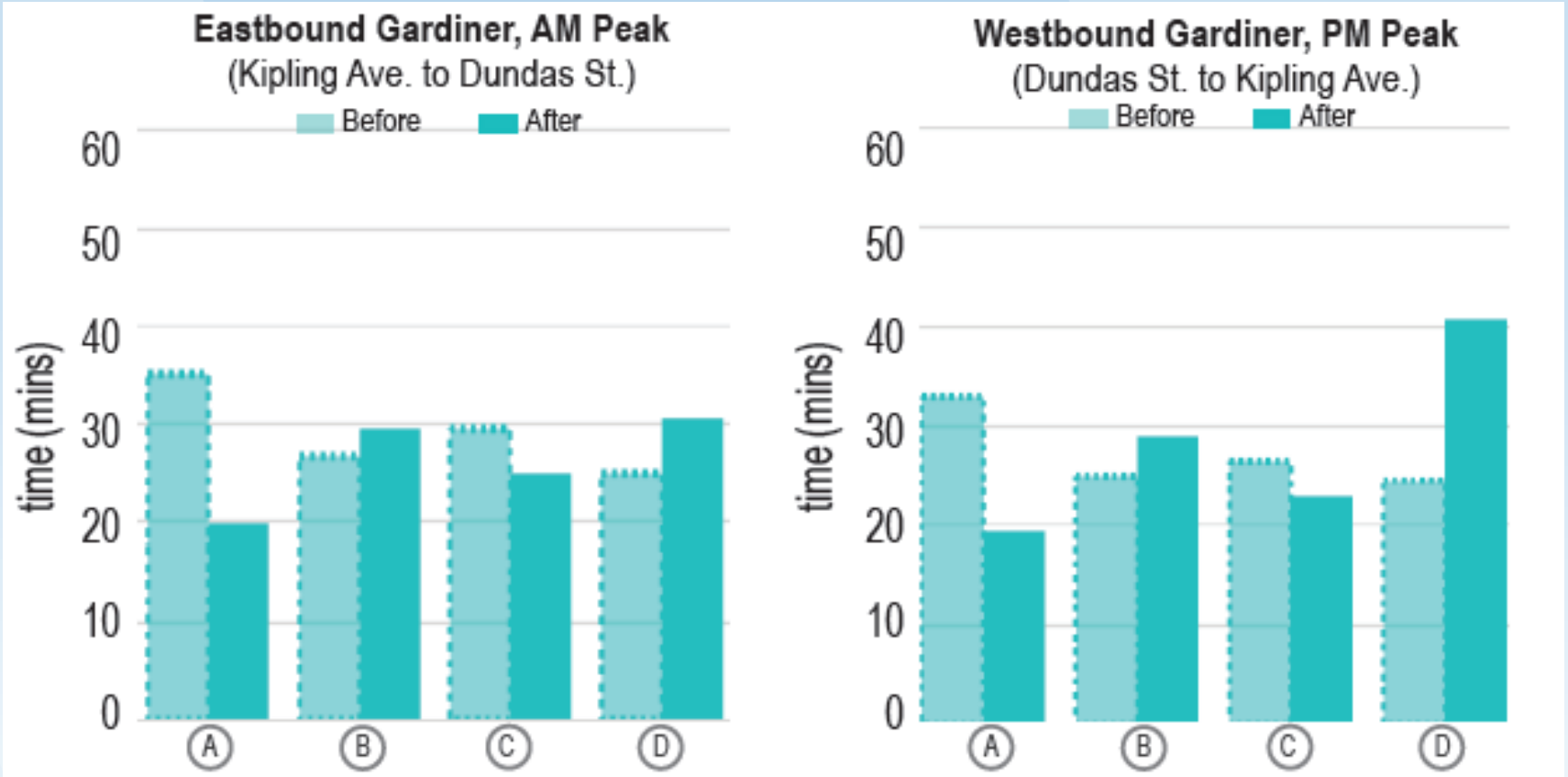


Most Congested Roads by Month

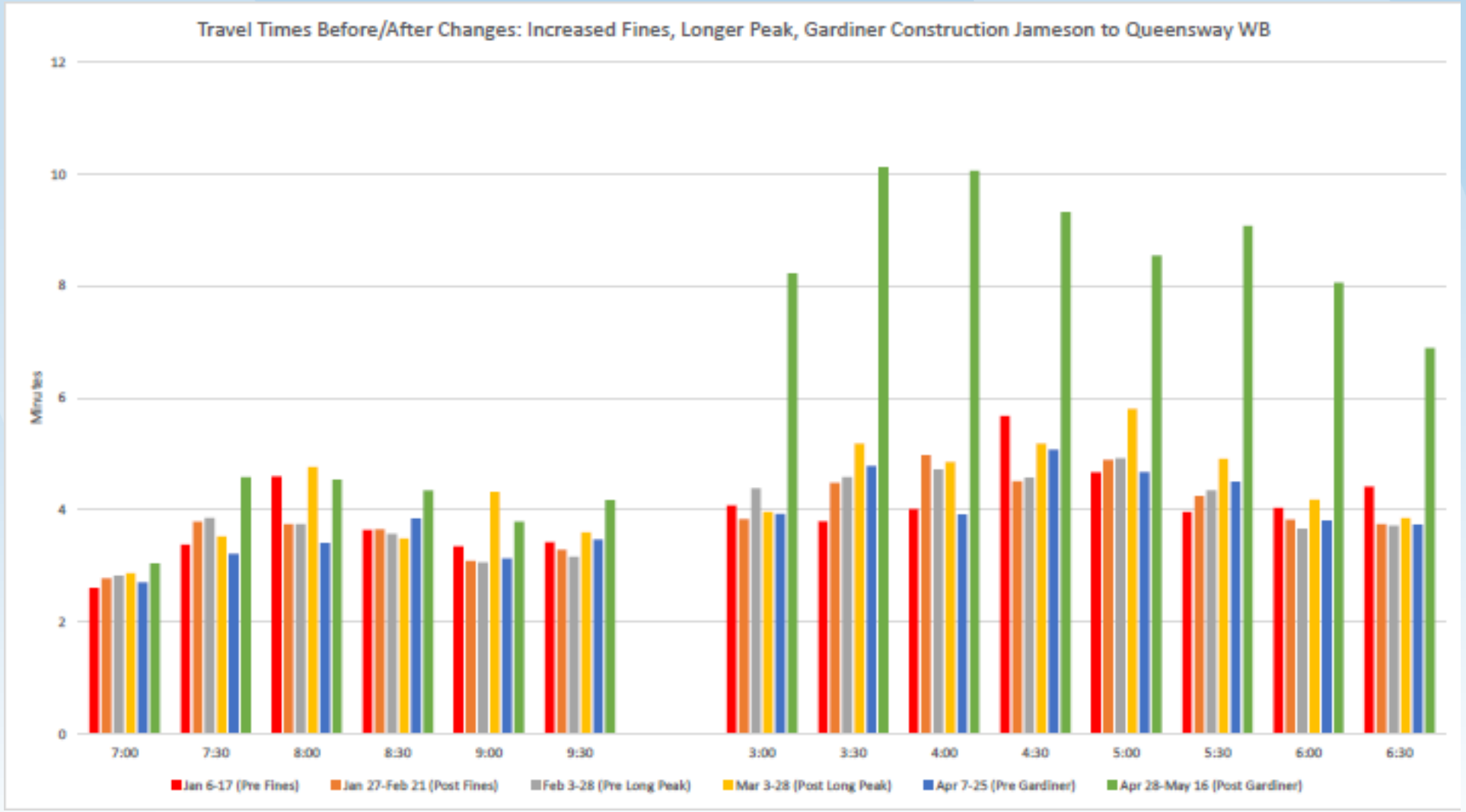


Evaluating

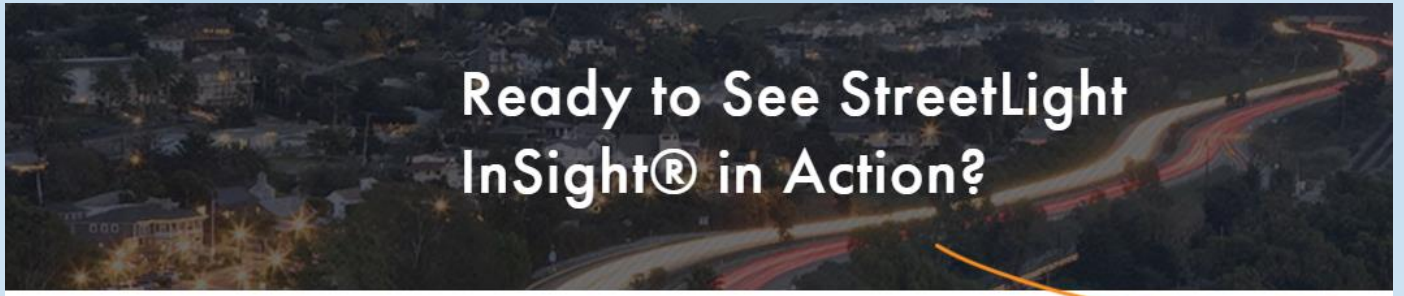
Before and During Gardiner Construction/Pan AM HOV



TTC AVL Data


Travel Times Before/After Changes: Increased Fines, Longer Peak, Gardiner Construction Jameson to Queensway WB
Minutes
0
2
4
6
8
10
12
7:00
7:30
8:00
8:30
9:00
9:30
3:00
3:30
4:00
4:30
5:00
5:30
6:00
6:30
Jan 6-17 (Pre Fines)
Jan 27-Feb 21 (Post Fines)
Feb 3-28 (Pre Long Peak)
Mar 3-28 (Post Long Peak)
Apr 7-25 (Pre Gardiner)
Apr 28-May 16 (Post Gardiner)

Real Time Monitoring of Travel Patterns

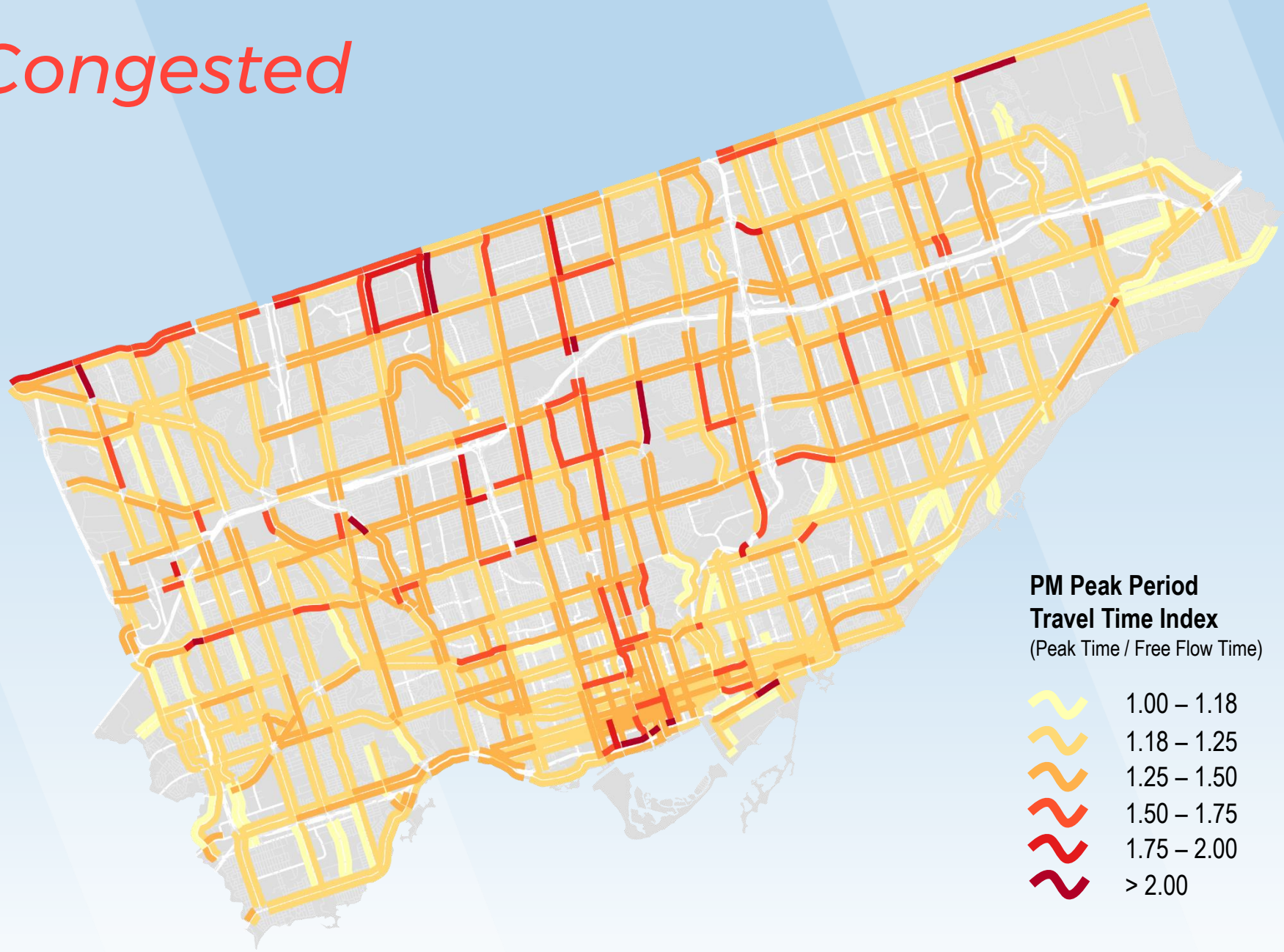


StreetLight InSight is an online platform that offers the best Big Data resources for understanding travel patterns - and the processing software that makes Big Data useful.

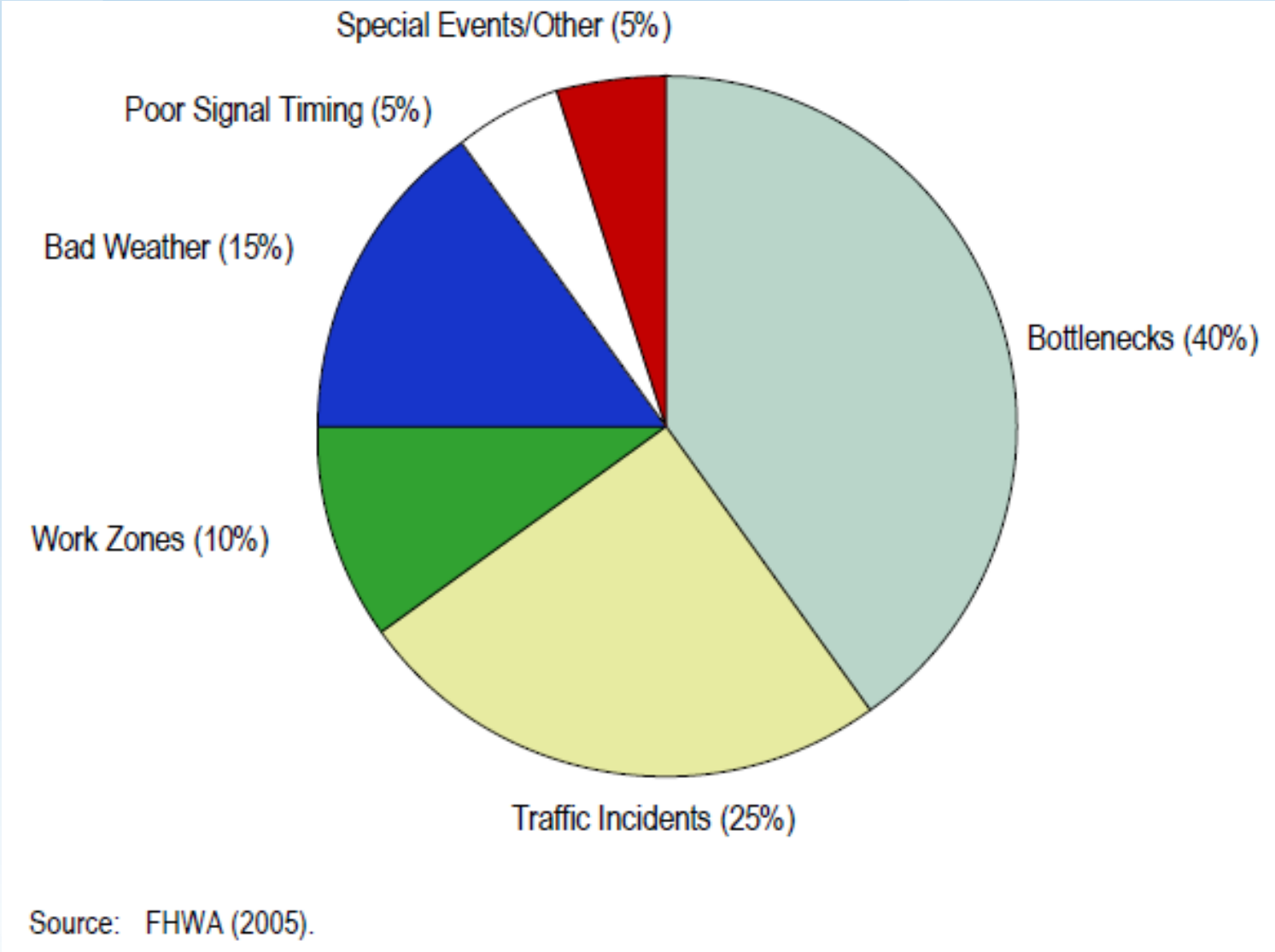
Fill out this form to watch **all of our demo videos.**

Operating

Most Congested



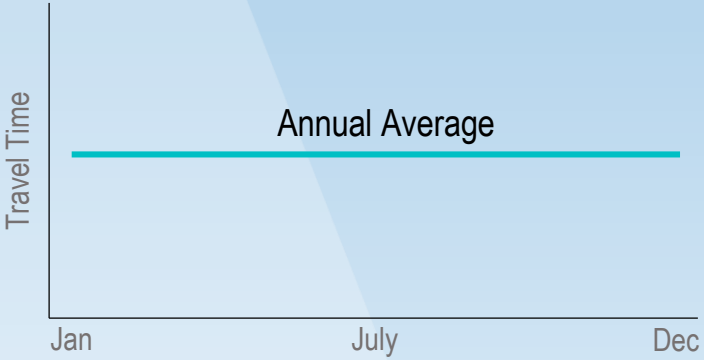
Causes of Congestion



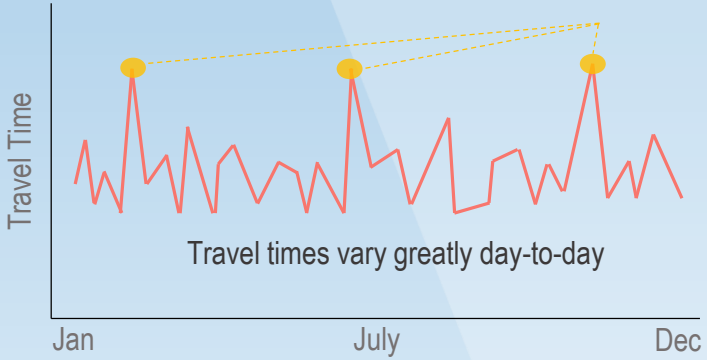
Source: FHWA (2005).

Perception of Congestion

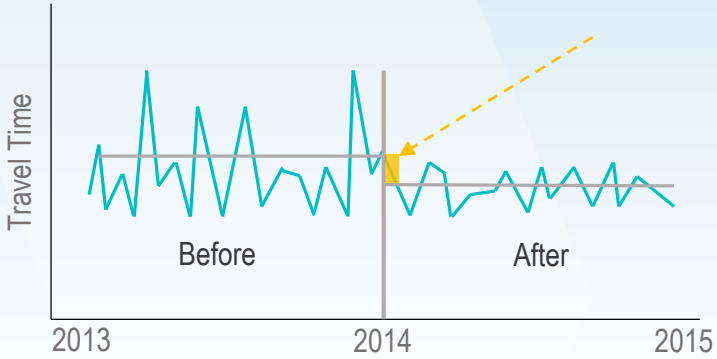
How traffic conditions have been communicated



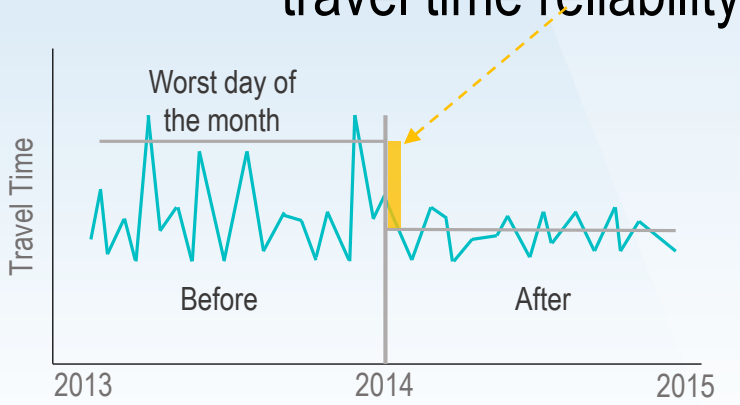
What travellers experience…



Small improvement in average travel time

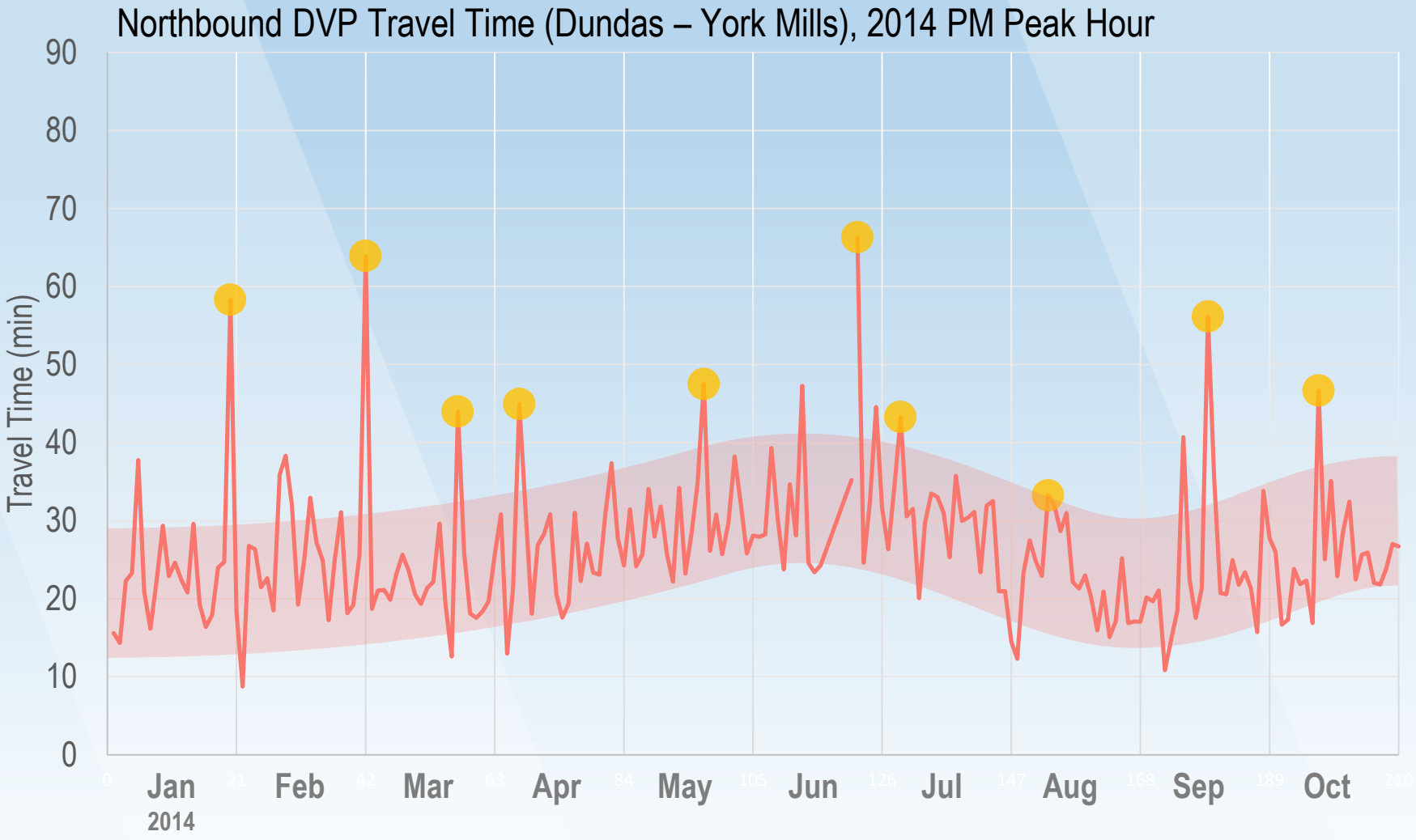


Large improvement in travel time reliability

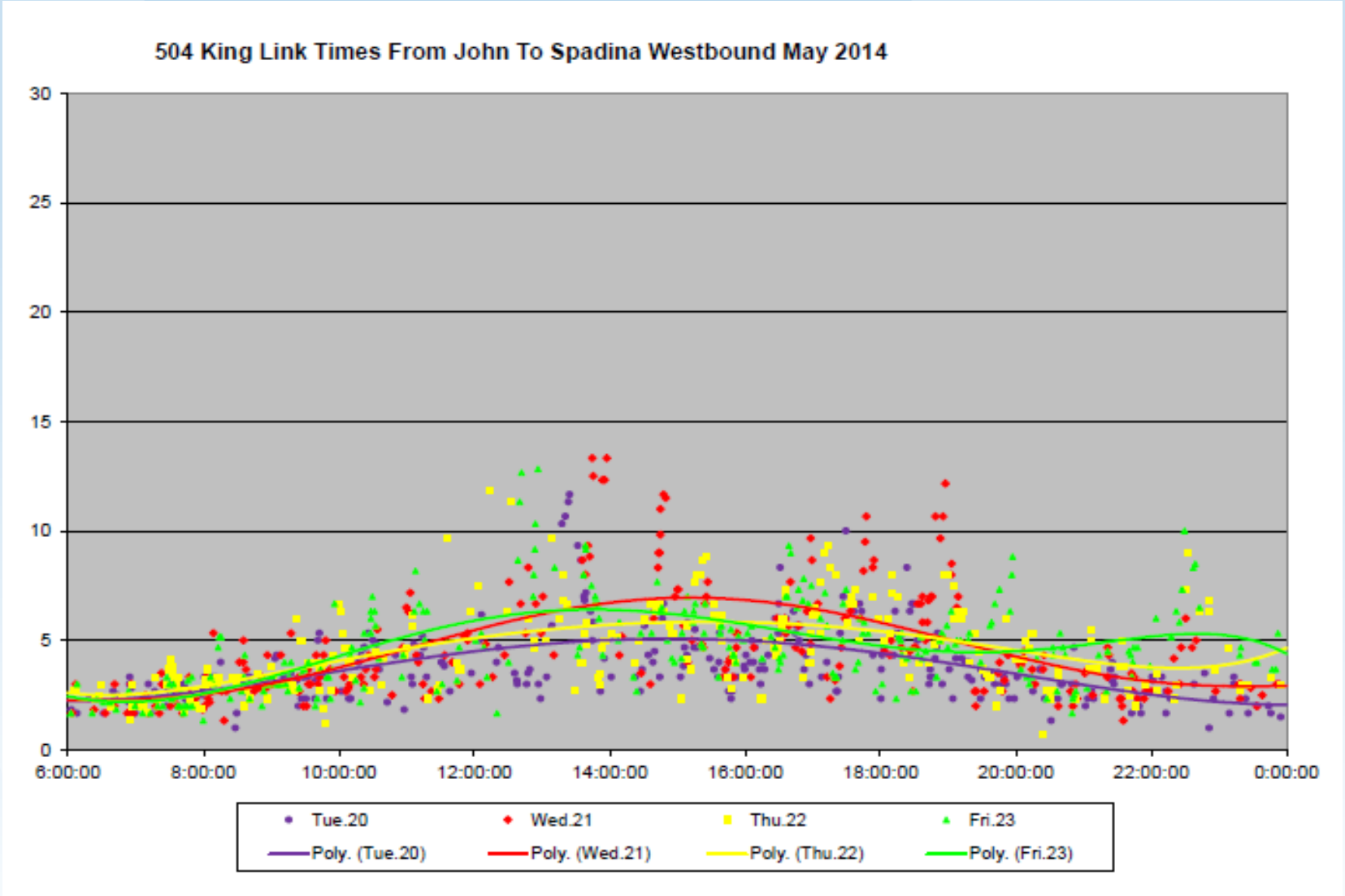


Source: FHWA

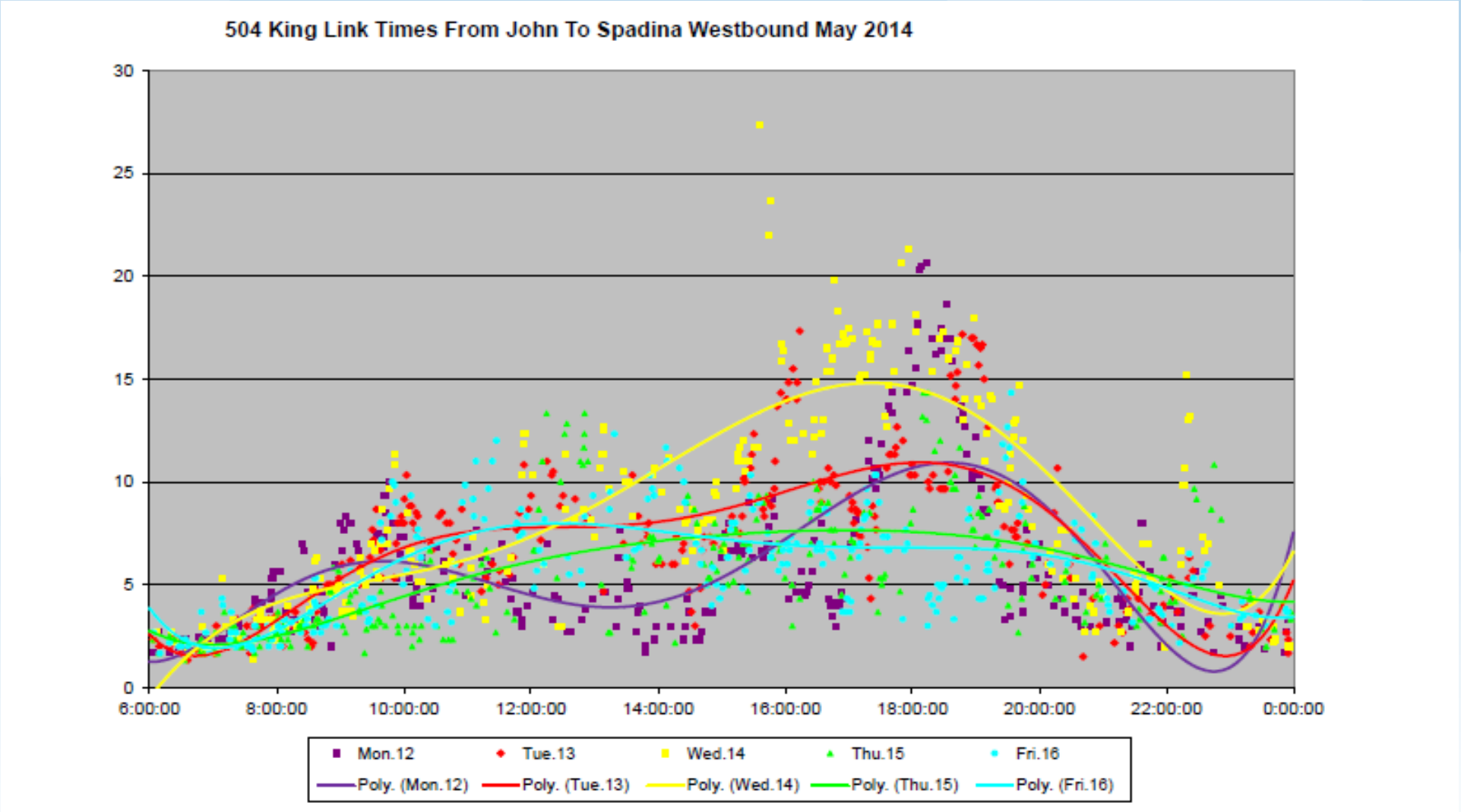
What we were seeing in Toronto



TTC AVL Data


504 King Link Times From John To Spadina Westbound May 2014
30
25
20
15
10
5
0
6:00:00
8:00:00
10:00:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
0:00:00
Tue.20
Wed.21
Thu.22
Fri.23
Poly. (Tue.20)
Poly. (Wed.21)
Poly. (Thu.22)
Poly. (Fri.23)

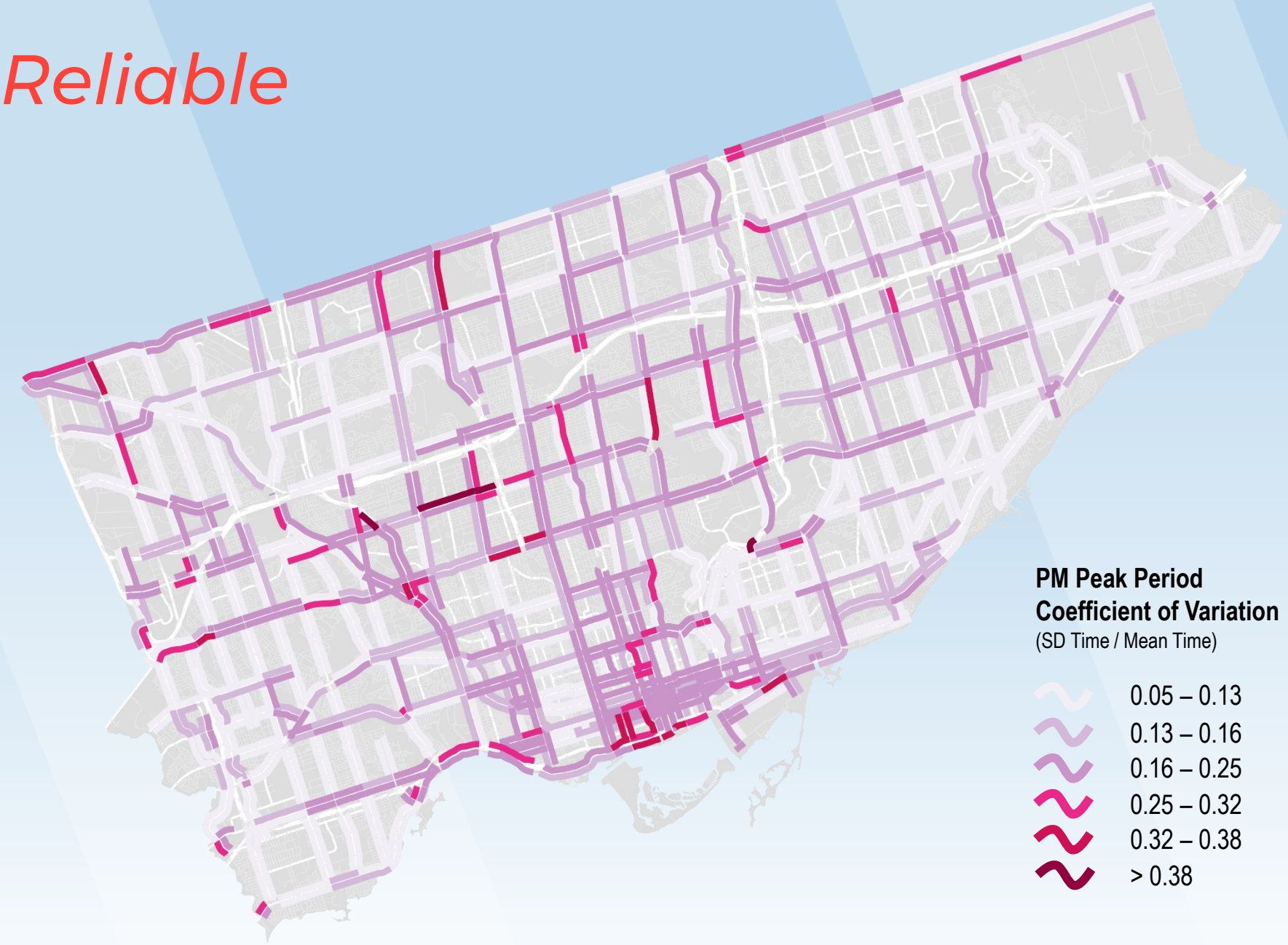
TTC AVL Data


504 King Link Times From John To Spadina Westbound May 2014
30
25
20
15
10
5
0
6:00:00
8:00:00
10:00:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
0:00:00
Mon.12
Tue.13
Wed.14
Thu.15
Fri.16
Poly. (Mon.12)
Poly. (Tue.13)
Poly. (Wed.14)
Poly. (Thu.15)
Poly. (Fri.16)

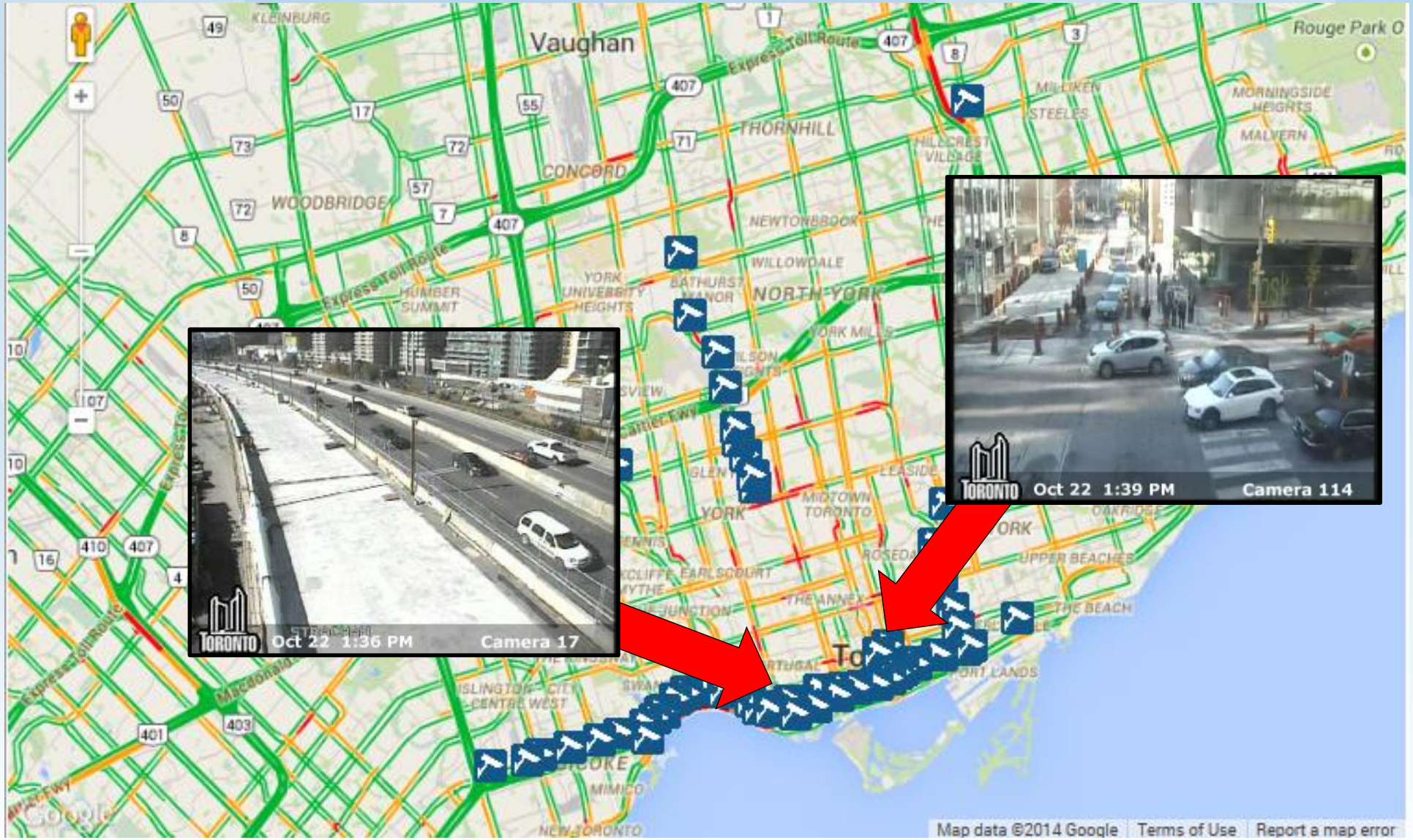
Factors Impacting Congestion and Variability

- Regional Growth
- Private Sector Construction
- Public Sector Construction
- O&M (repairs, winter maintenance, new connections, etc.)
- Rise of On-Demand Delivery
- Ride-hailing

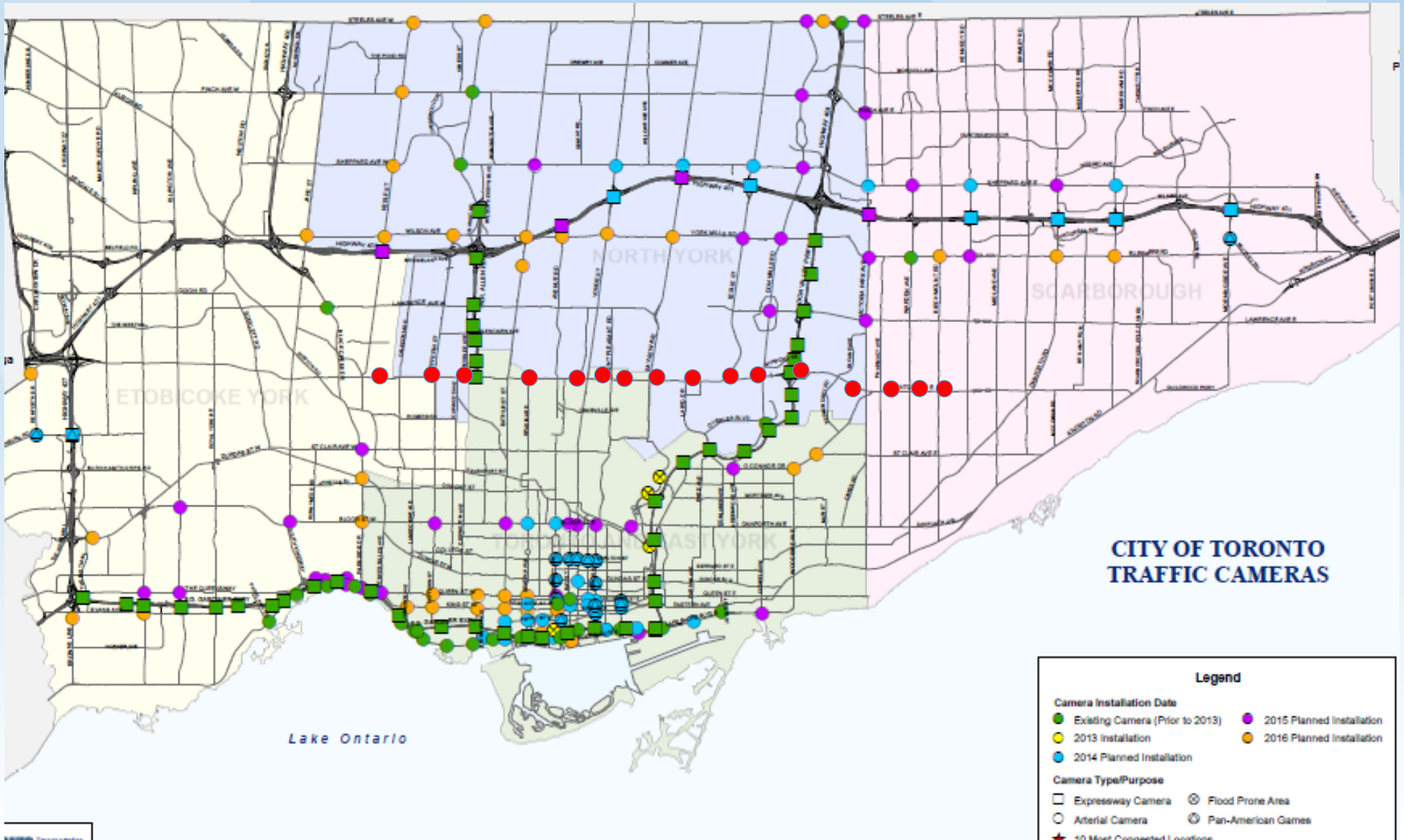
Least Reliable



Operations

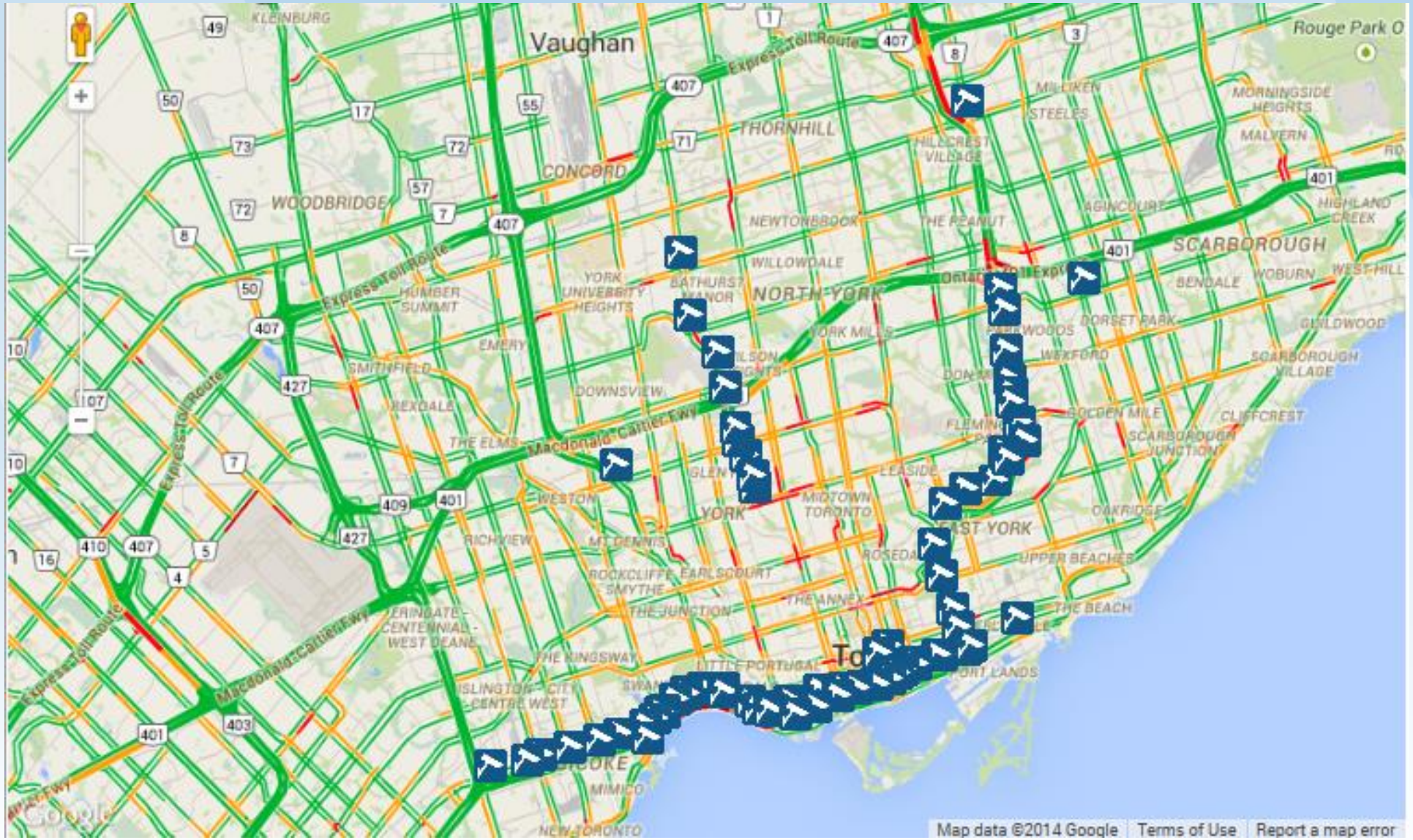

Vaughan
KLEINBURG
WOODBRIDGE
CONCORD
THORNHILL
NEWTONBROOK
WILLOWDALE
NORTH YORK
YORK MILLS
YORK UNIVERSITY HEIGHTS
BATHURST MANOR
HUMBER SUMMIT
MILLIKEN
STEELES
MORNINGSIDE HEIGHTS
MALVERN
HILLCREST VILLAGE
Rouge Park
MIDTOWN TORONTO
LEASIDE
UPPER BEACHES
THE BEACH
EARLSCOURT
MIMICO
NEW TORONTO
Express Toll Route
Macdonald
TORONTO
Oct 22 1:36 PM
Camera 17
TORONTO
Oct 22 1:39 PM
Camera 114
Map data ©2014 Google
Terms of Use
Report a map error

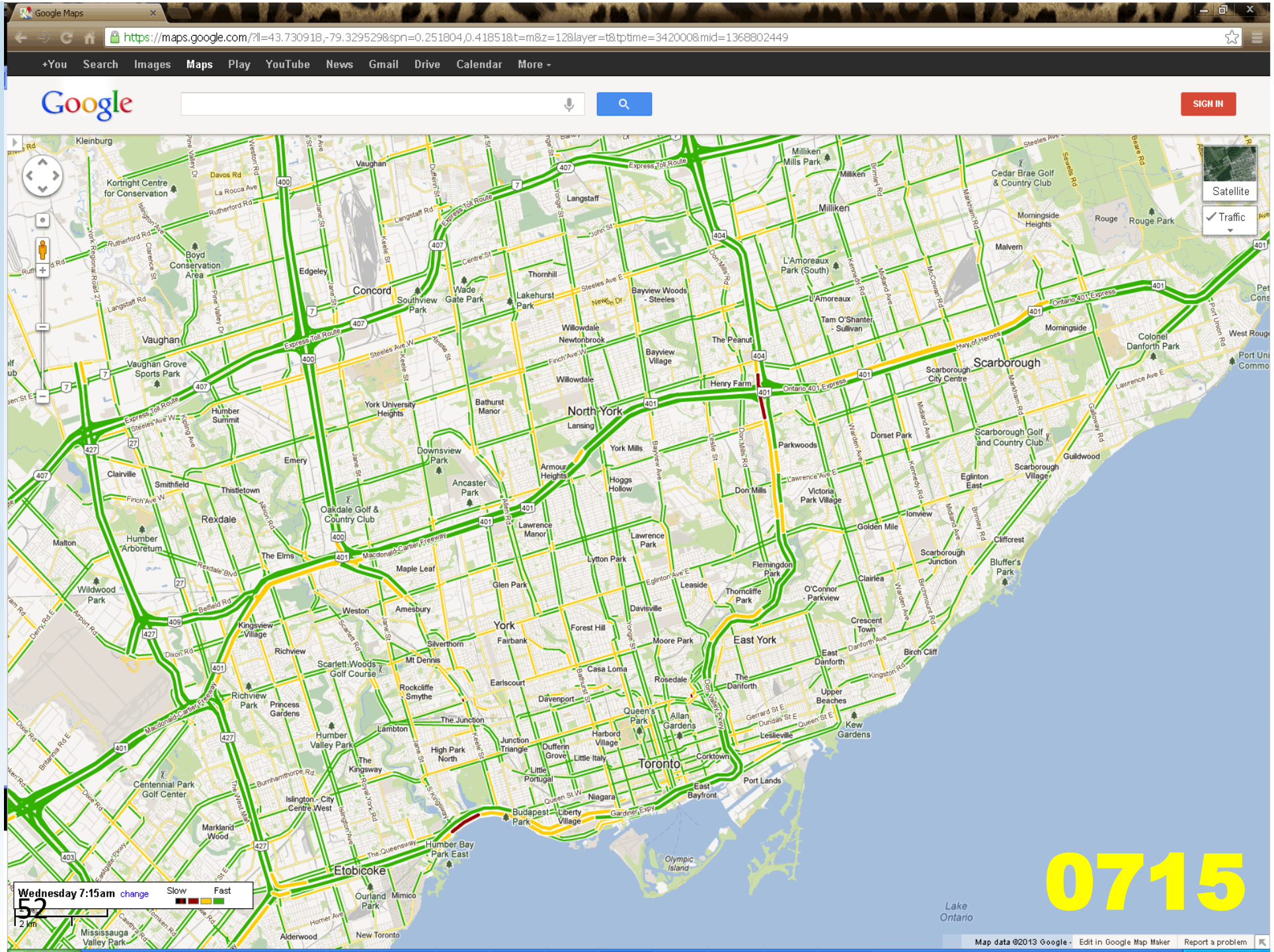
Arterial Camera Program (2016 Build-out)



Transportation Operations Centre

Not Speed.....but "Different from Normal"

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+You Search Images Maps Play YouTube News Gmail Drive Calendar More
Google
SIGN IN
Satellite
Traffic
Wednesday 7:15am change
Slow Fast
52
2 km
0715
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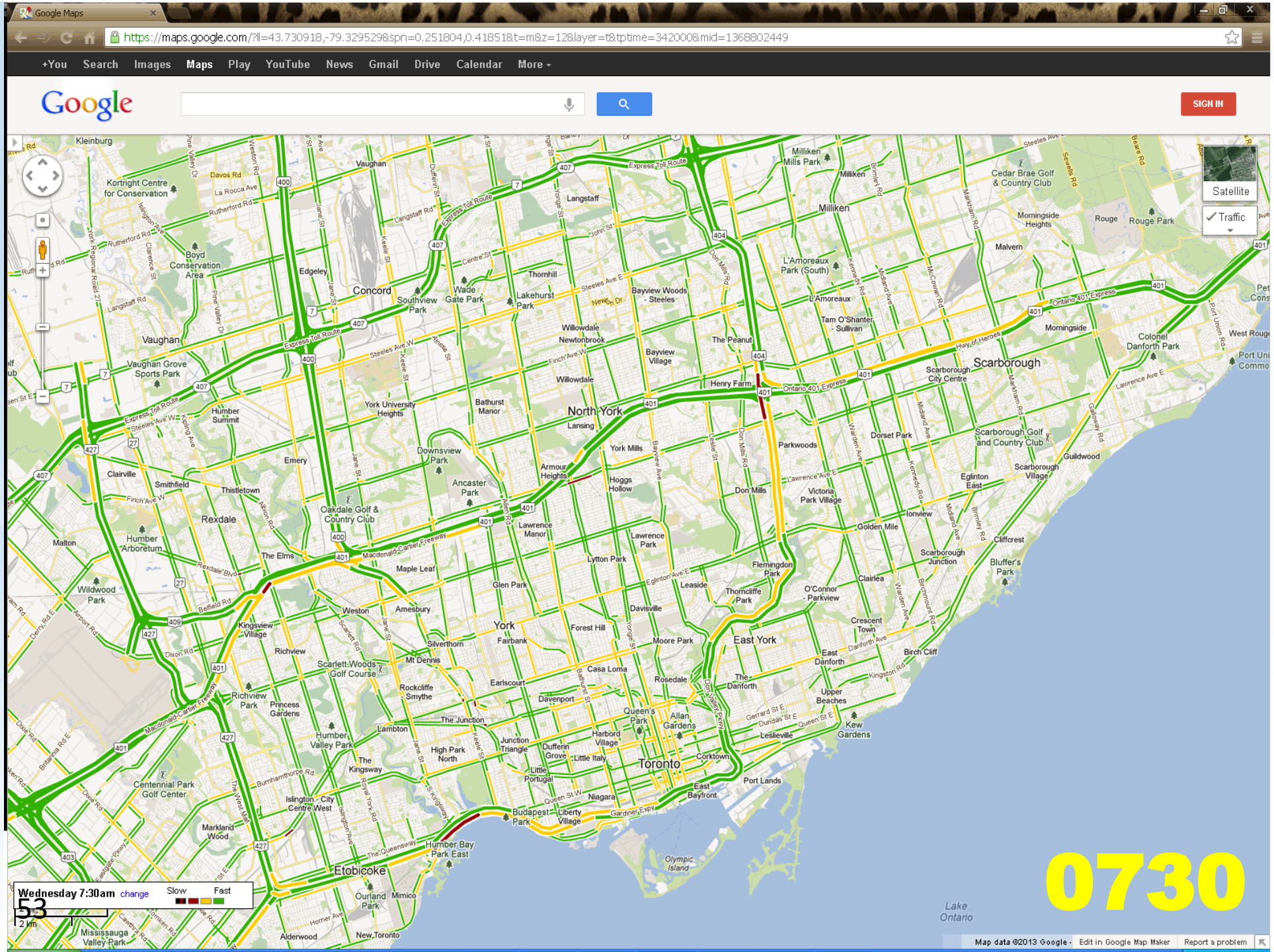
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Google
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Satellite
Traffic
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Slow Fast
53
0730
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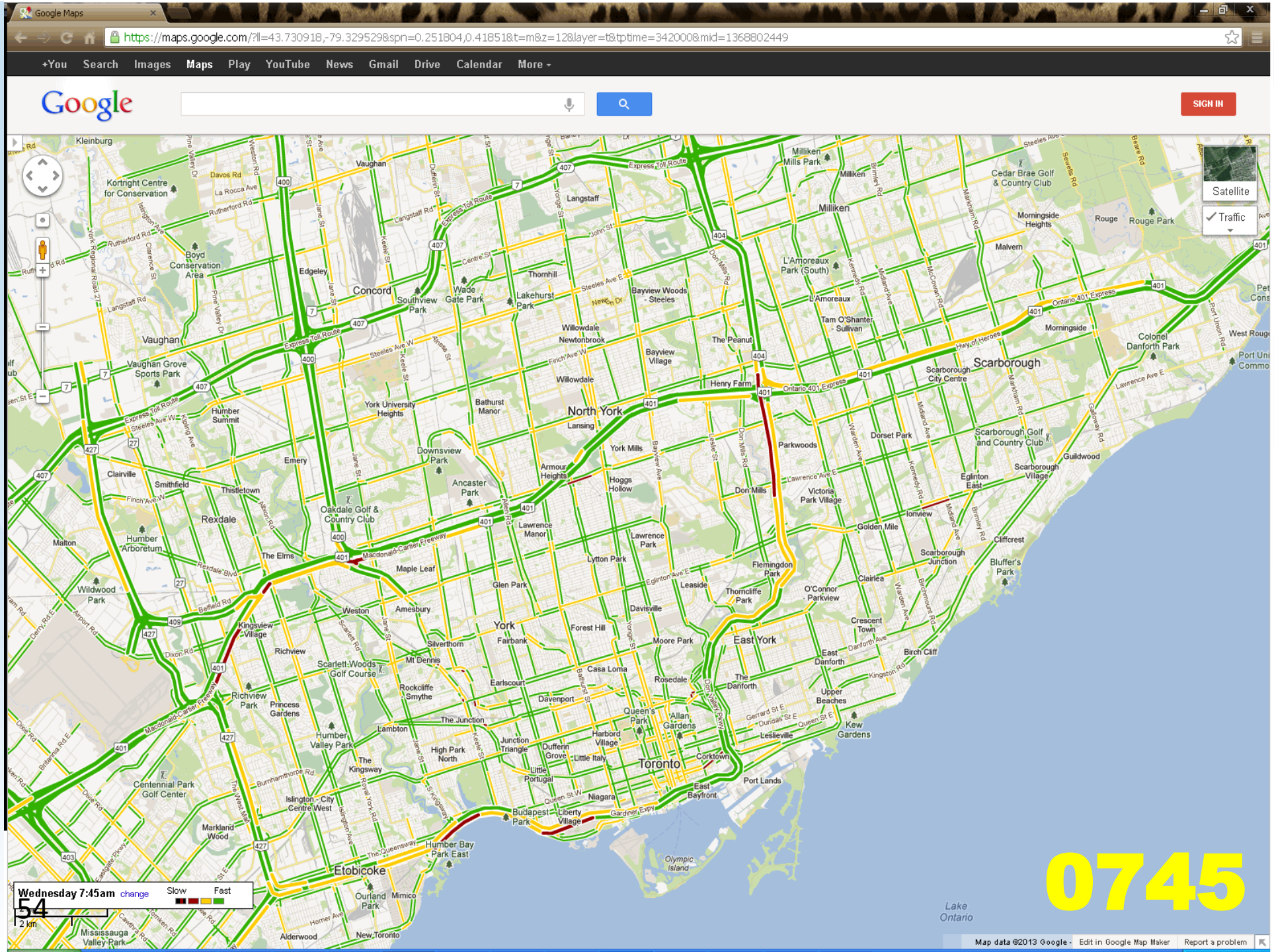
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Google
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Traffic
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Slow Fast
54
2 km
0745
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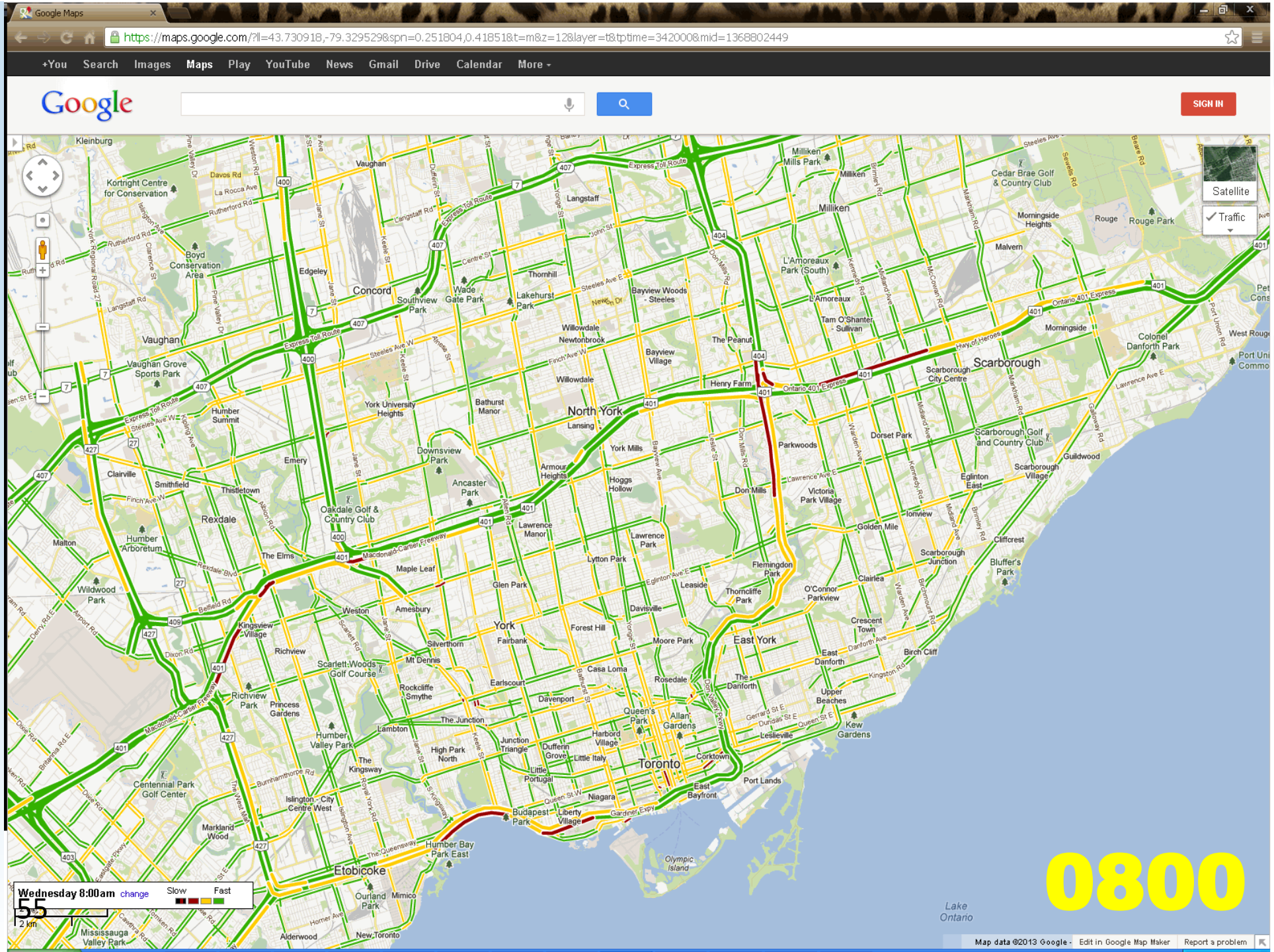
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Slow Fast
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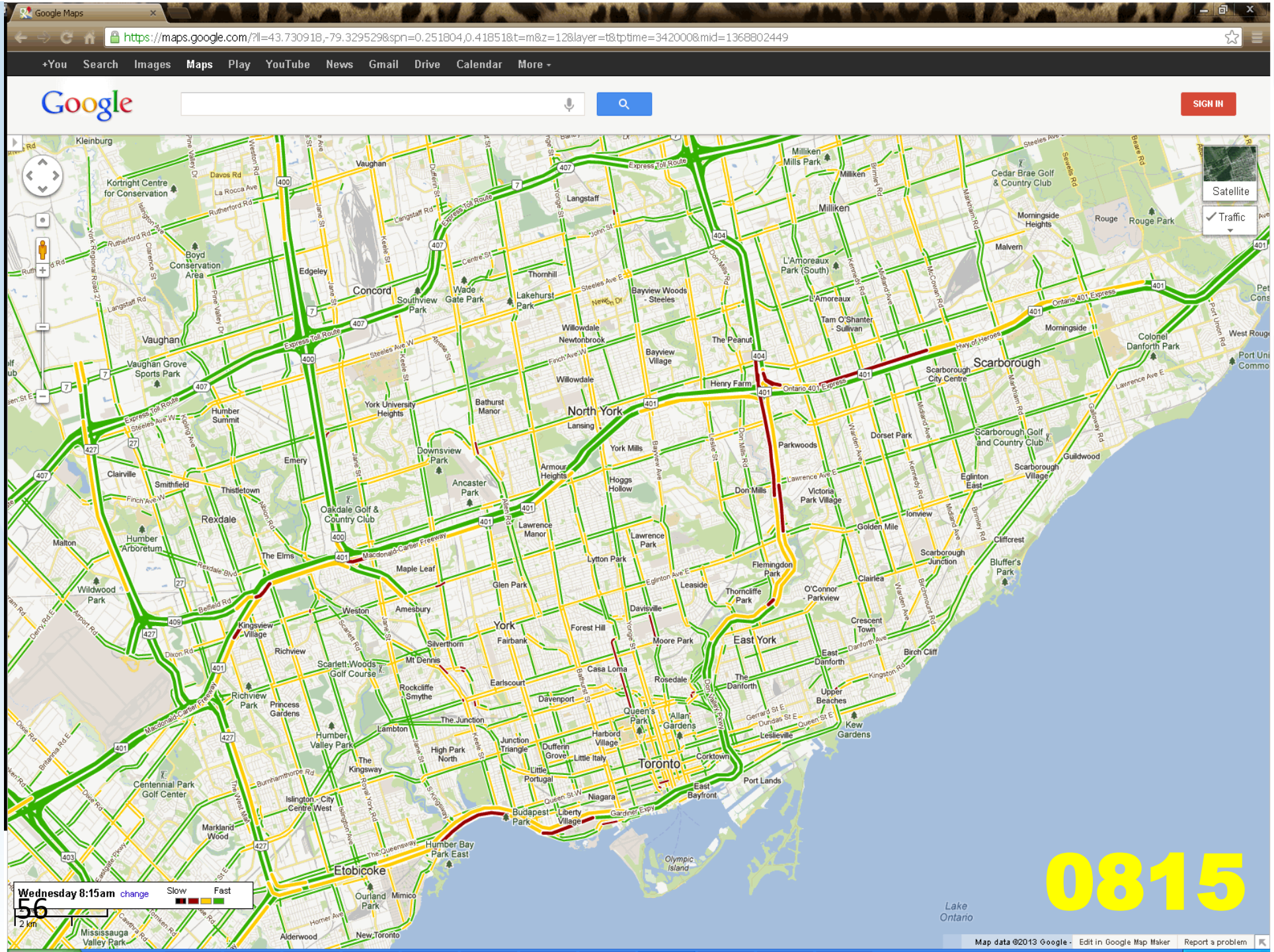
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56
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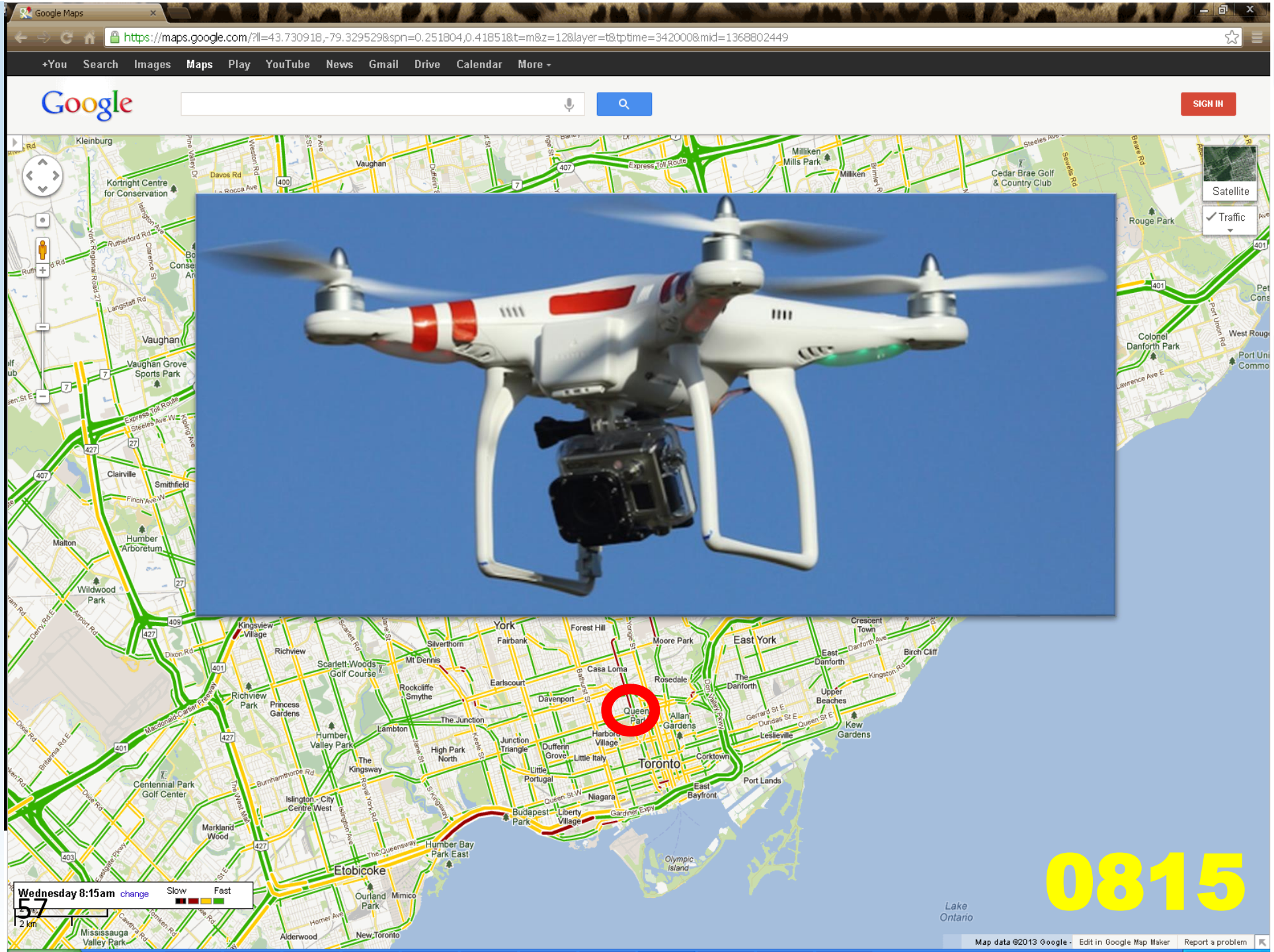
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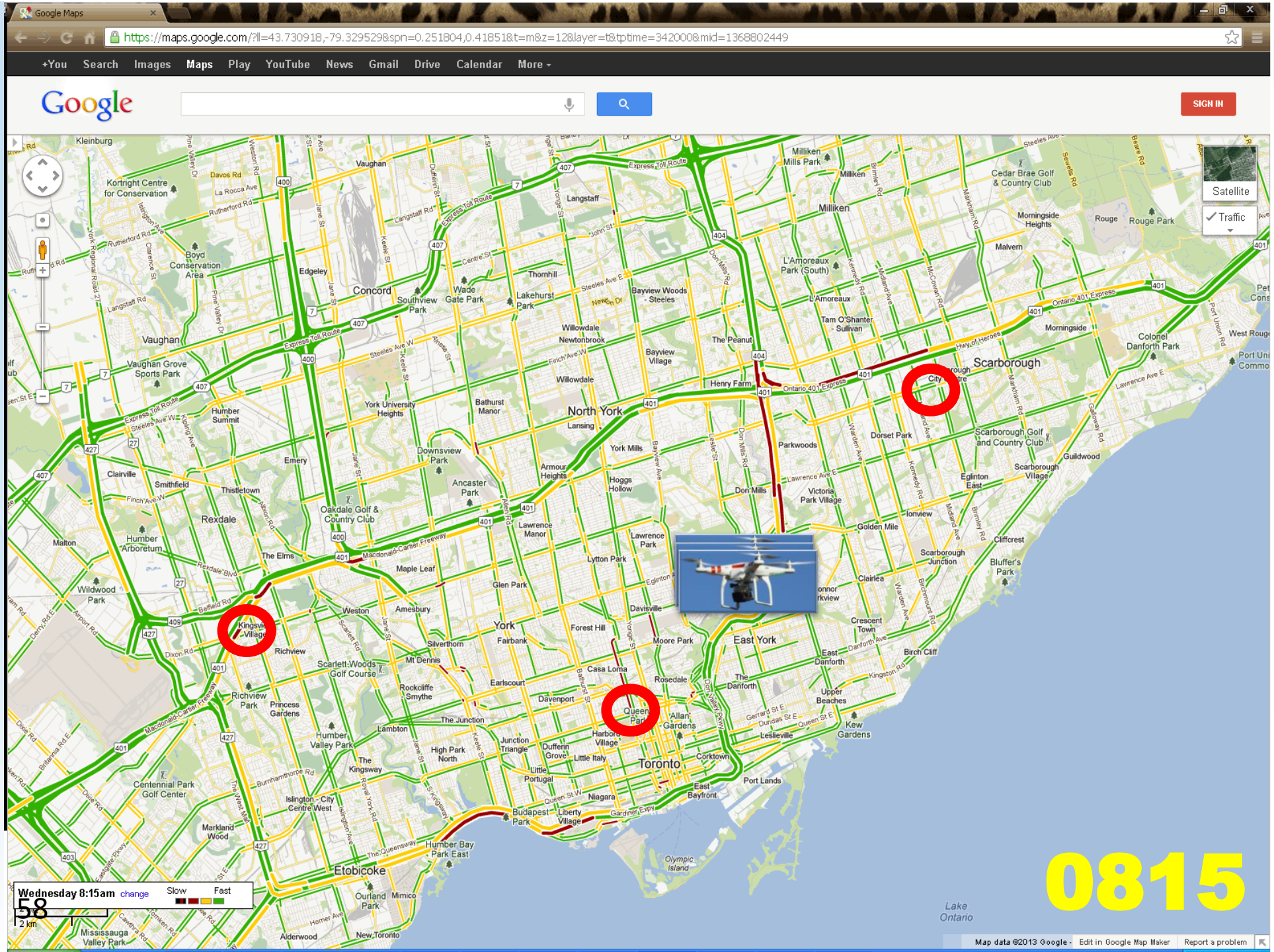
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Slow Fast
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UAV Demo

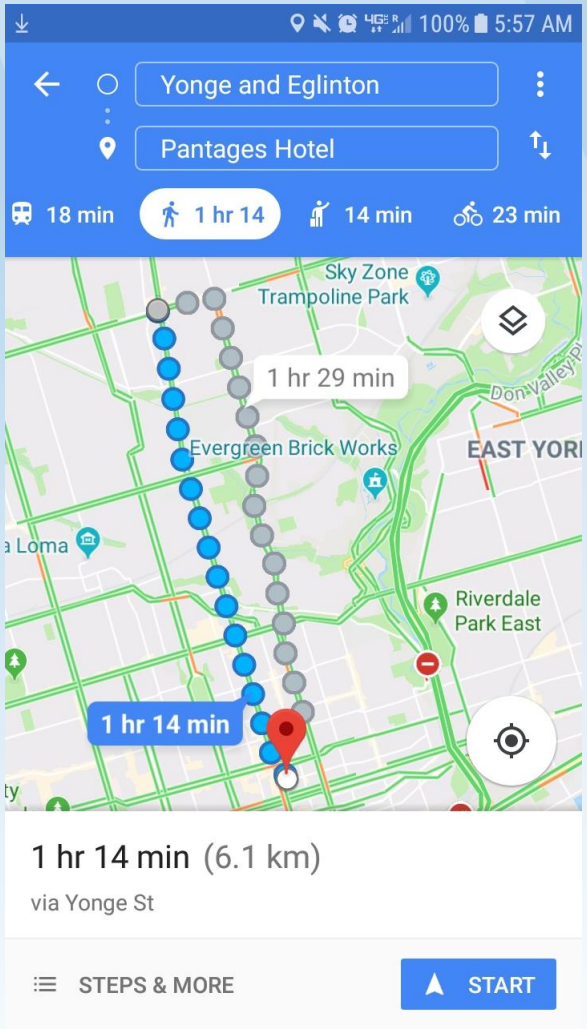
UAV Demo

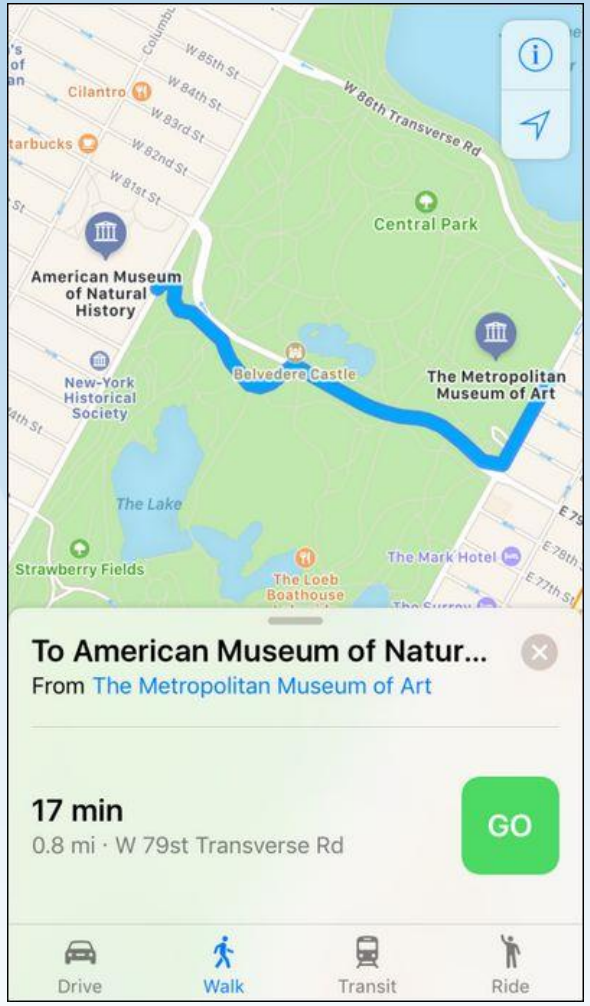
UAV Demo

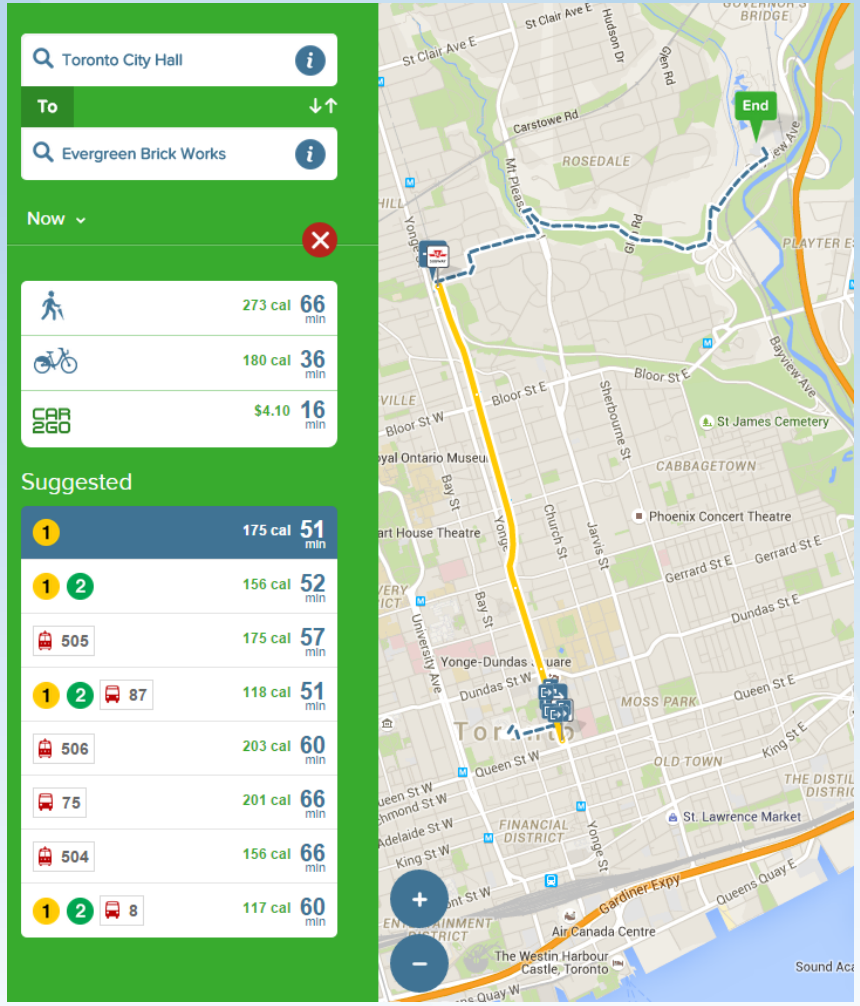
http://portal.cvst.ca/

Predicting

Predictive Tools







Predictive Tools

waze

GreenOWL mobile

Google Maps

Actionable Information

1 Data Sources

PROBE
- Cycling App
- TTC AVL
- Bluetooth Probe
- GPS Probe

COUNT
- Cycle & Ped Counts
- RESCU Detectors
- Traffic Counts

EVENT
- Weather
- Road Closures
- Collisions / Incidents

2 Projects

1. VALIDATING
- Validating GPS Probe Data

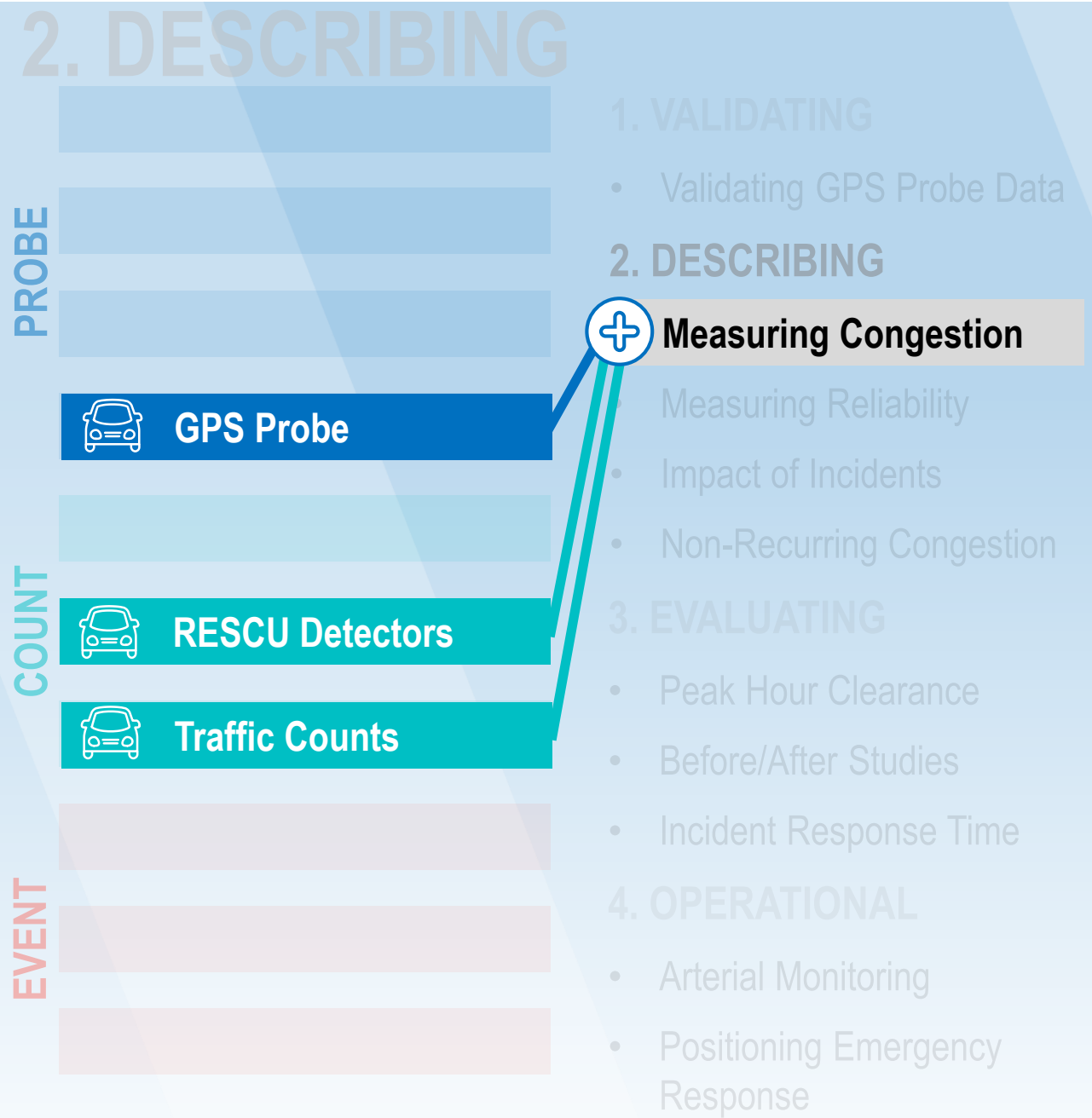
2. DESCRIBING
- Measuring Congestion
- Measuring Reliability
- Impact of Incidents
- Non-Recurring Congestion

3. EVALUATING
- Peak Hour Clearance
- Before/After Studies
- Incident Response Time

4. OPERATIONAL
- Arterial Monitoring
- Positioning Emergency Response

3 Key Questions
- What questions can be addressed under each project?

4 Potential Actions
- What actionable information will these projects supply?

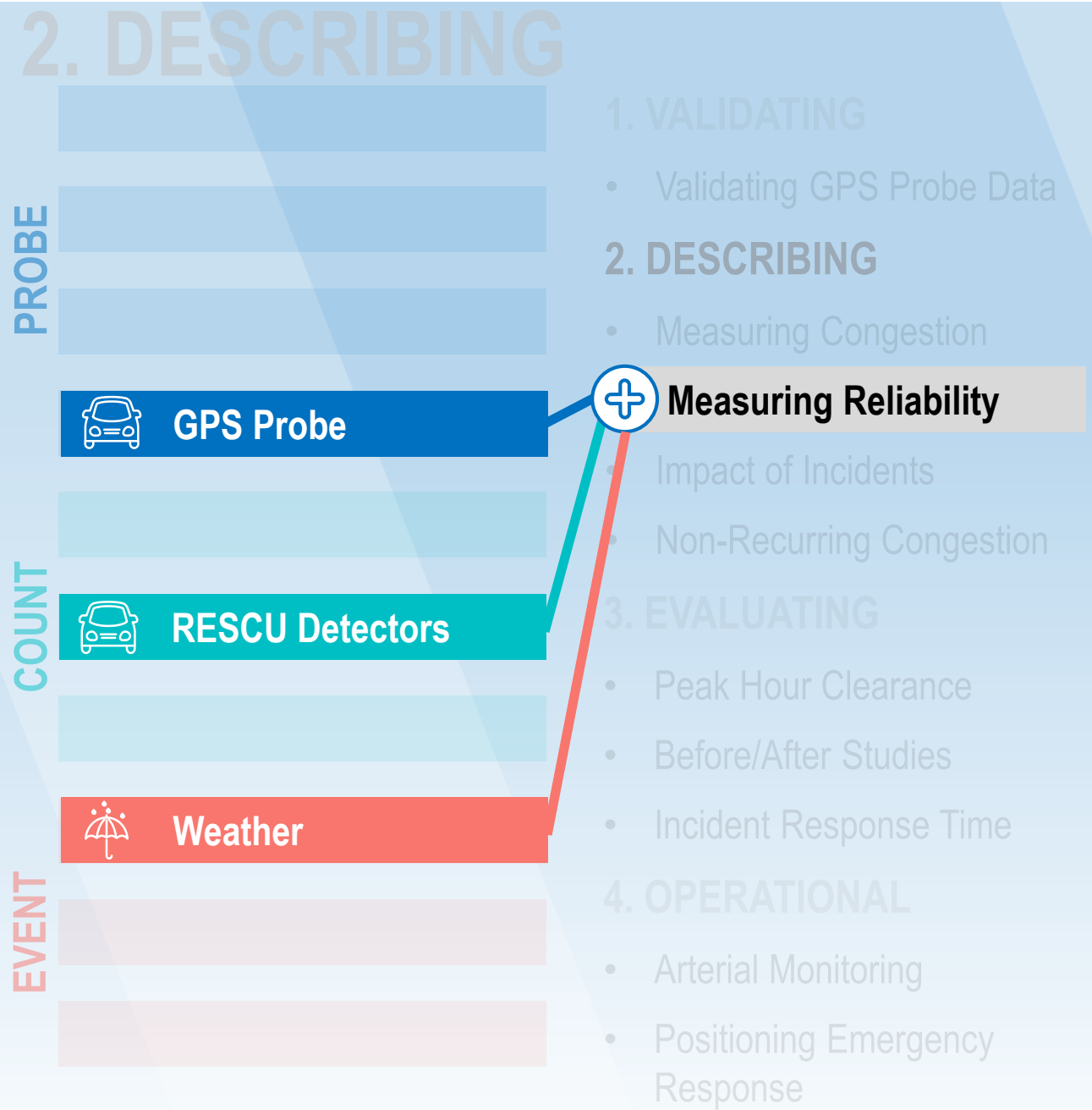


Key Questions

- How is congestion changing?

Potential Actions

- Ability to communicate congestion to the public
- Better understanding for policy, planning and operational decisions
- Audits of segments and intersections for bottlenecks

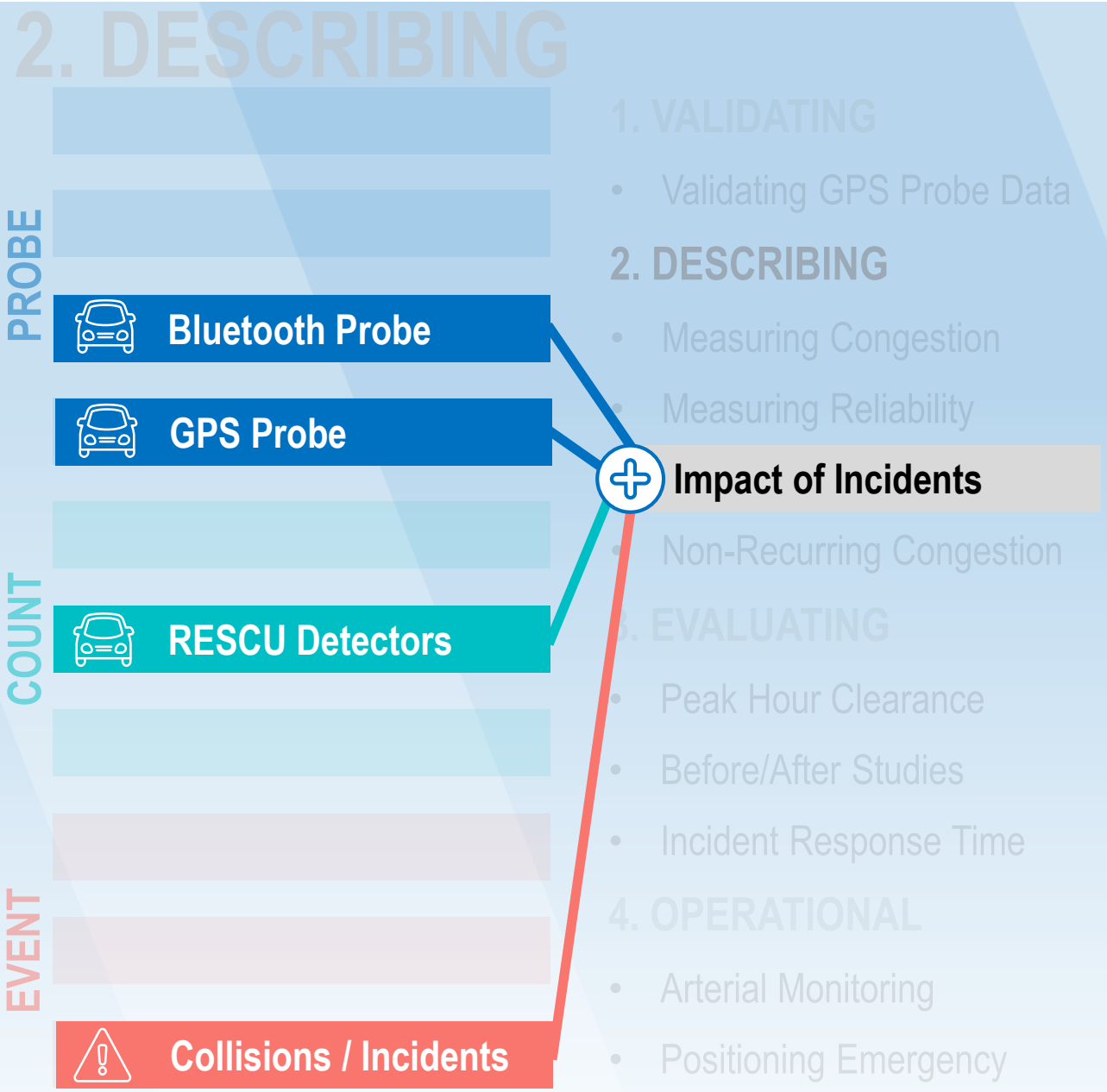


Key Questions

- What are the least reliable roads? And why?

Potential Actions

- Warn the public of anticipated impacts
- Target traffic management resources more effectively



Key Questions

- What are the impacts of incidents / collisions on travel times?

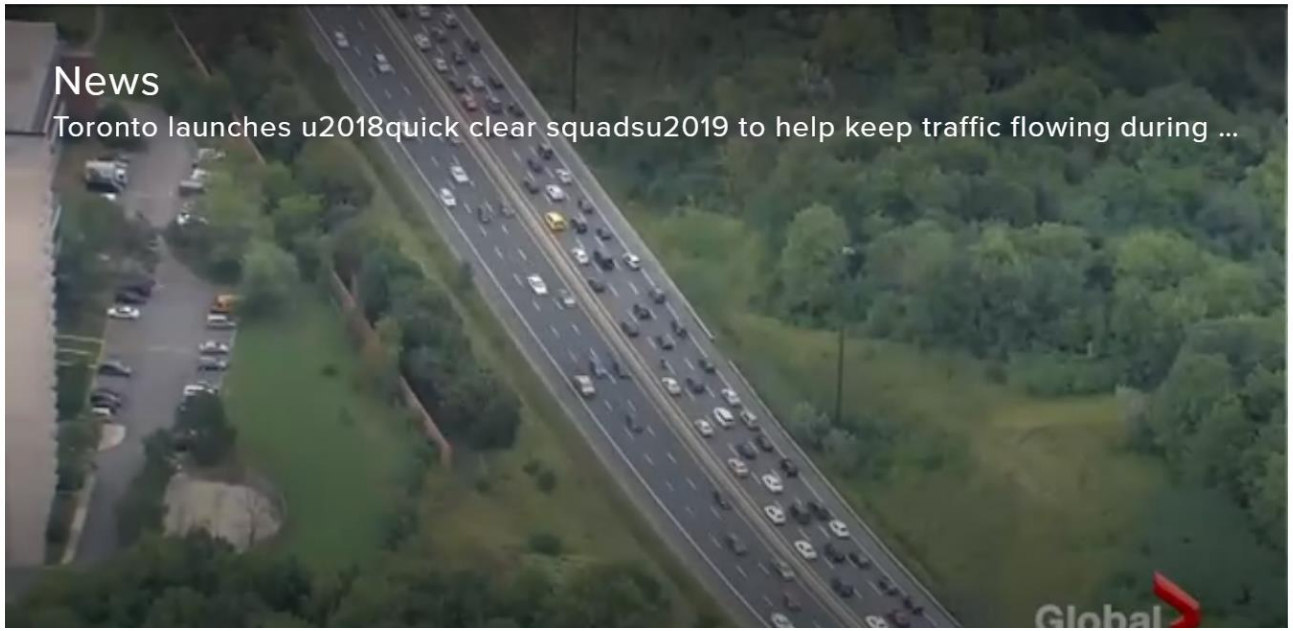
Potential Actions

- Make the case for better incident response

CANADA November 6, 2017 9:17 am Updated: November 6, 2017 1:44 pm

‘Quick clear squad’ pilot project on DVP, Gardiner receives positive reviews

By David Shum
Digital Broadcast Journalist Global News



WEATHER Toronto, ON

2°

Hi 11°
Lo 5°

Weather Few Clouds

Traffic Travel times & Incidents

Building Capacity

Integration of Skill Sets

Statistics / Data Analysis

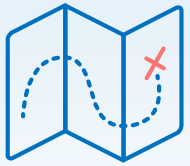
Computer Science

Design & Visualization

Database / Data Management

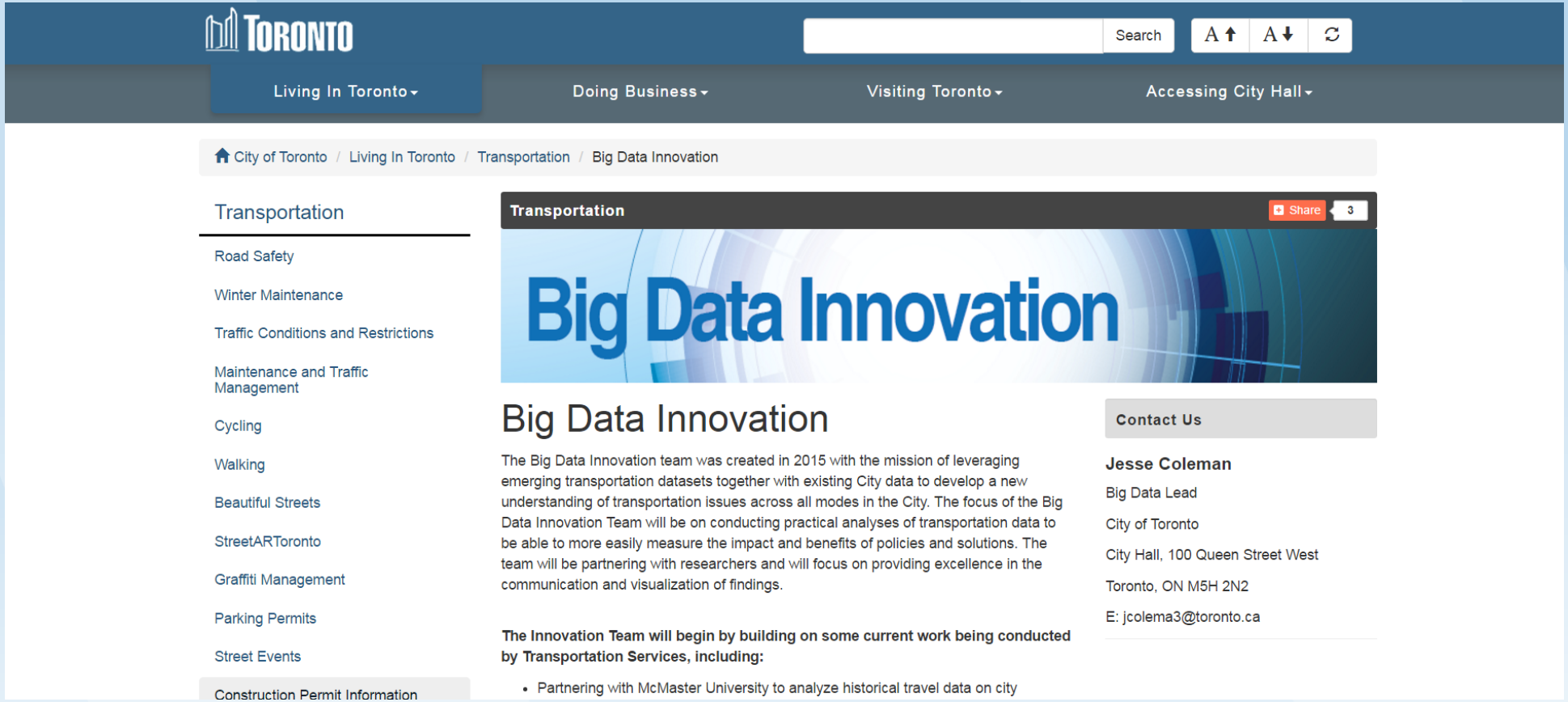
Transportation

Cartography / GIS



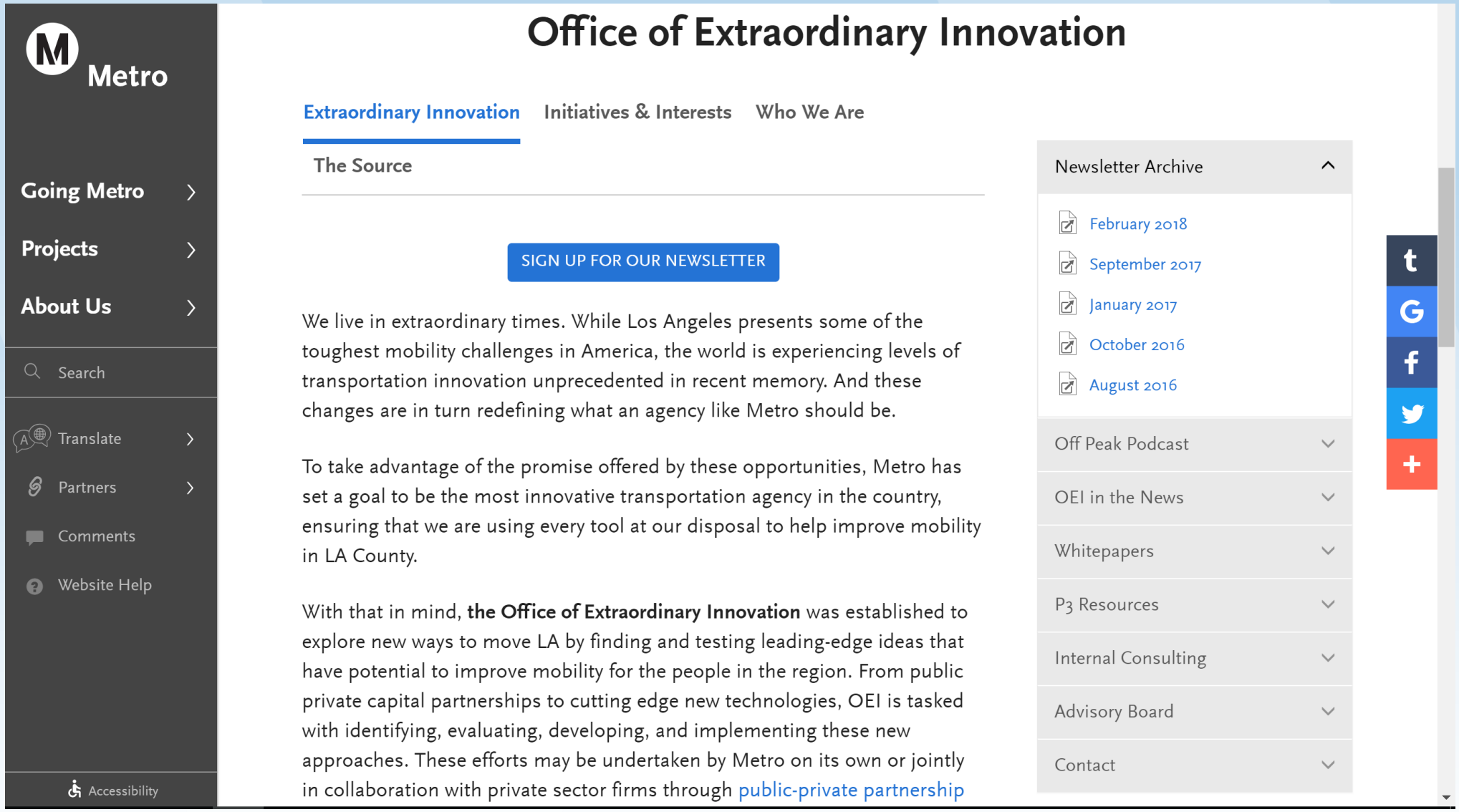
Technology and Analytics Team

- Build capacity and embed within your organization
- Dedicate resources
- Establish partnerships with academia
- Build a pipeline through internships
- Ensure a strong champion



Google: Toronto Big Data Innovation

LA Metro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Extraordinary Innovation
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Who We Are
The Source
SIGN UP FOR OUR NEWSLETTER
We live in extraordinary times. While Los Angeles presents some of the toughest mobility challenges in America, the world is experiencing levels of transportation innovation unprecedented in recent memory. And these changes are in turn redefining what an agency like Metro should be.
To take advantage of the promise offered by these opportunities, Metro has set a goal to be the most innovative transportation agency in the country, ensuring that we are using every tool at our disposal to help improve mobility in LA County.
With that in mind, the Office of Extraordinary Innovation was established to explore new ways to move LA by finding and testing leading-edge ideas that have potential to improve mobility for the people in the region. From public private capital partnerships to cutting edge new technologies, OEI is tasked with identifying, evaluating, developing, and implementing these new approaches. These efforts may be undertaken by Metro on its own or jointly in collaboration with private sector firms through public-private partnership
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Progress

AMERICAN ENTREPRENEURSHIP TODAY
Advancing Innovation & Entrepreneurship All Across America

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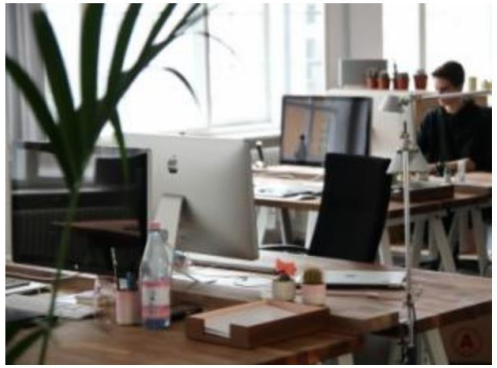
Public Procurement Technology Innovation Labs Launching in Los Angeles via Public Spend Forum's Collaboration with the Los Angeles Mayor's Office

May 09, 2018



Public Spend Forum which is a market intelligence platform and community for public sector buyers and suppliers is collaborating with the **Los Angeles Mayor's Office** to launch a new lab that showcases new and disruptive approaches and technologies in government called the Public Procurement Technology and Innovation Labs. The Innovation Labs will serve to connect emerging and established procurement technology firms, experts, and entrepreneurs with government agencies when it launches on June 6th, 2018. The **Shatter Fund** which invests capital in

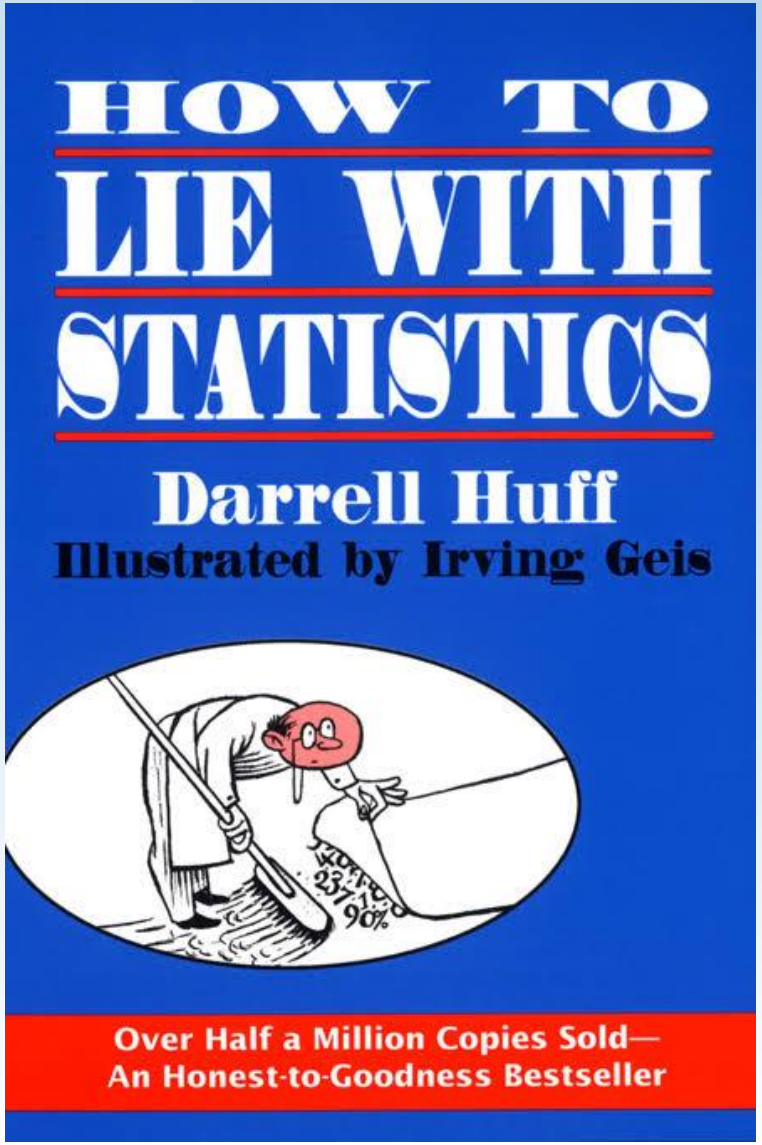
http://bigdatabigcities2016.org/

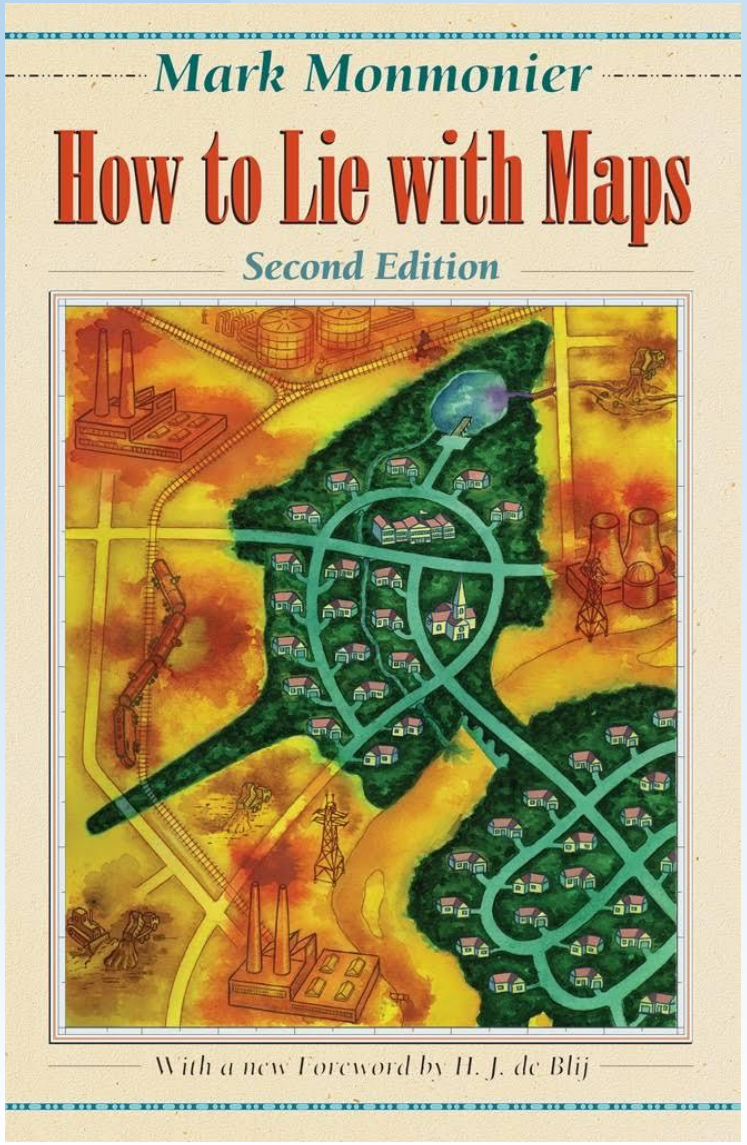
DC Mobility Report

Getting Started

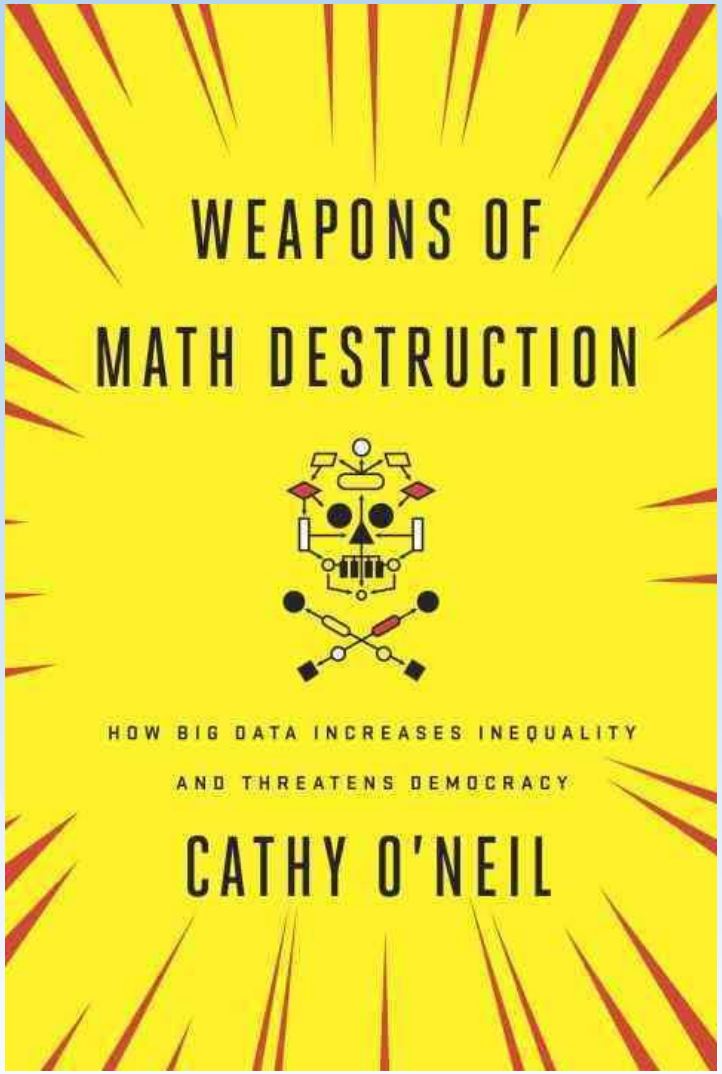
- Partner with an institution that can support you
- Prepare an inventory of existing City data sets
- Develop your “making the case” strategy for generating support
- Conduct research on existing and new data sets, including opportunities & limitations
- Develop a data improvement strategy; Investigate data procurement
- Avoid getting into primary data collection; consider purchasing *information*
- Identify quick win projects to show value
- Borrow liberally (R&D program)
- Perfect is the enemy of really good, but understand limitations!
- Manage the expectations of your senior leadership

Offense through Defense





Understanding the Dangers of Data-Driven Models



Practical Uses of Big Transportation Data for Cities and Municipalities

Stephen Buckley, P.E., AICP
stephen.buckley@wsp.com