



K2C2 Transportation

Critical Sums Analysis

November 17, 2011

Overview of Critical Sums Analysis



- Critical Sums Analysis is a planning tool used to evaluate build-out scenarios
- Compares how different levels of build-out impacts specific intersections in general way
- Not a traffic engineering tool
- Same methodology used in prior planning studies:
 - 2001 Citywide Rezoning
 - 2001 ECaPS
 - 2004 Concord-Alewife Plan

Critical Sums Methodology



Street 1: $(A + 2) + D$ or $(C + 2) + B$, whichever is more

Street 2: $E + H$ or $G + F$, whichever is more

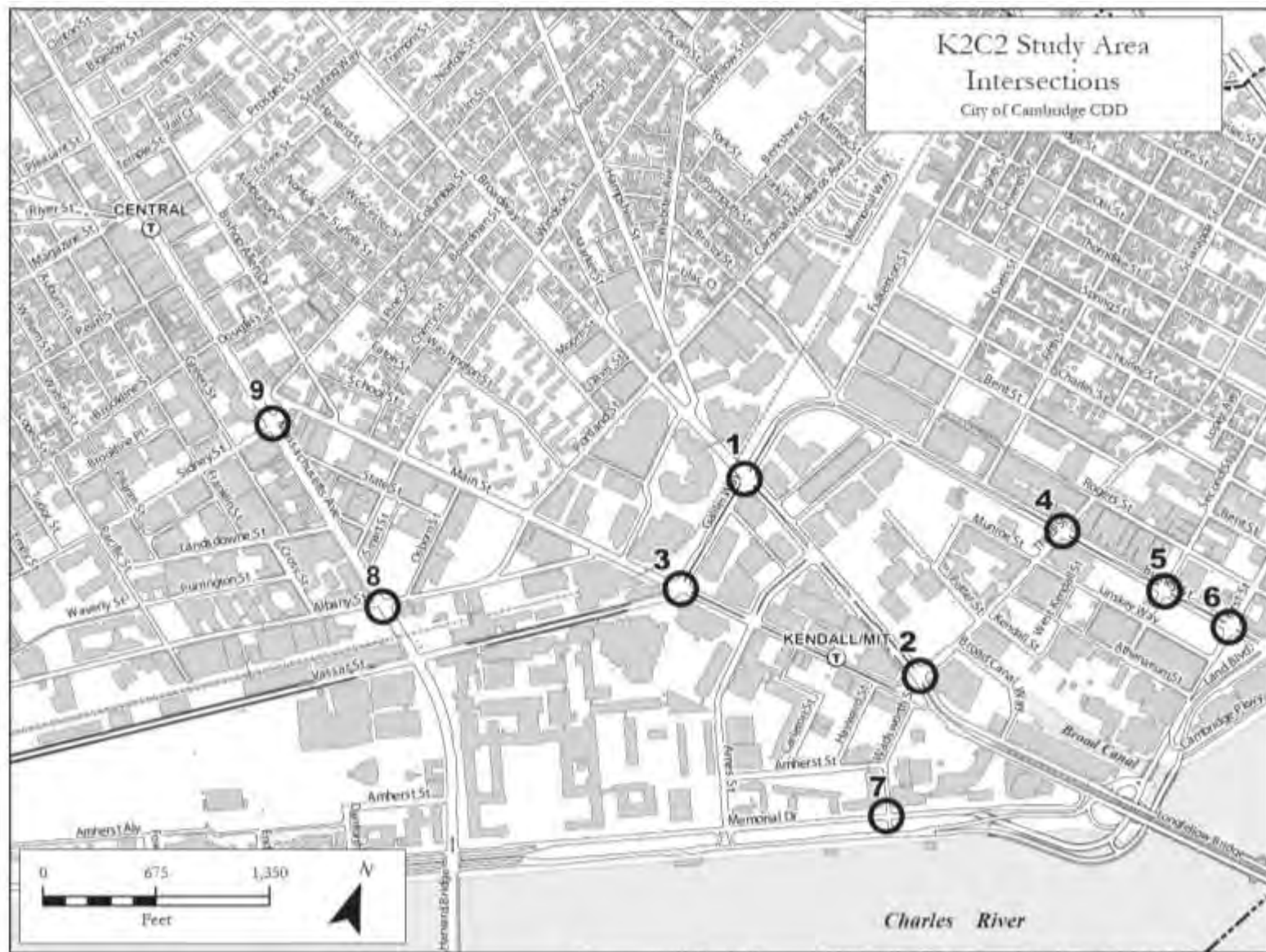
Critical Sum = Result of Street 1 + Street 2

Critical movement volume at an intersection is the sum of all conflicting traffic movements (vehicles per hour).

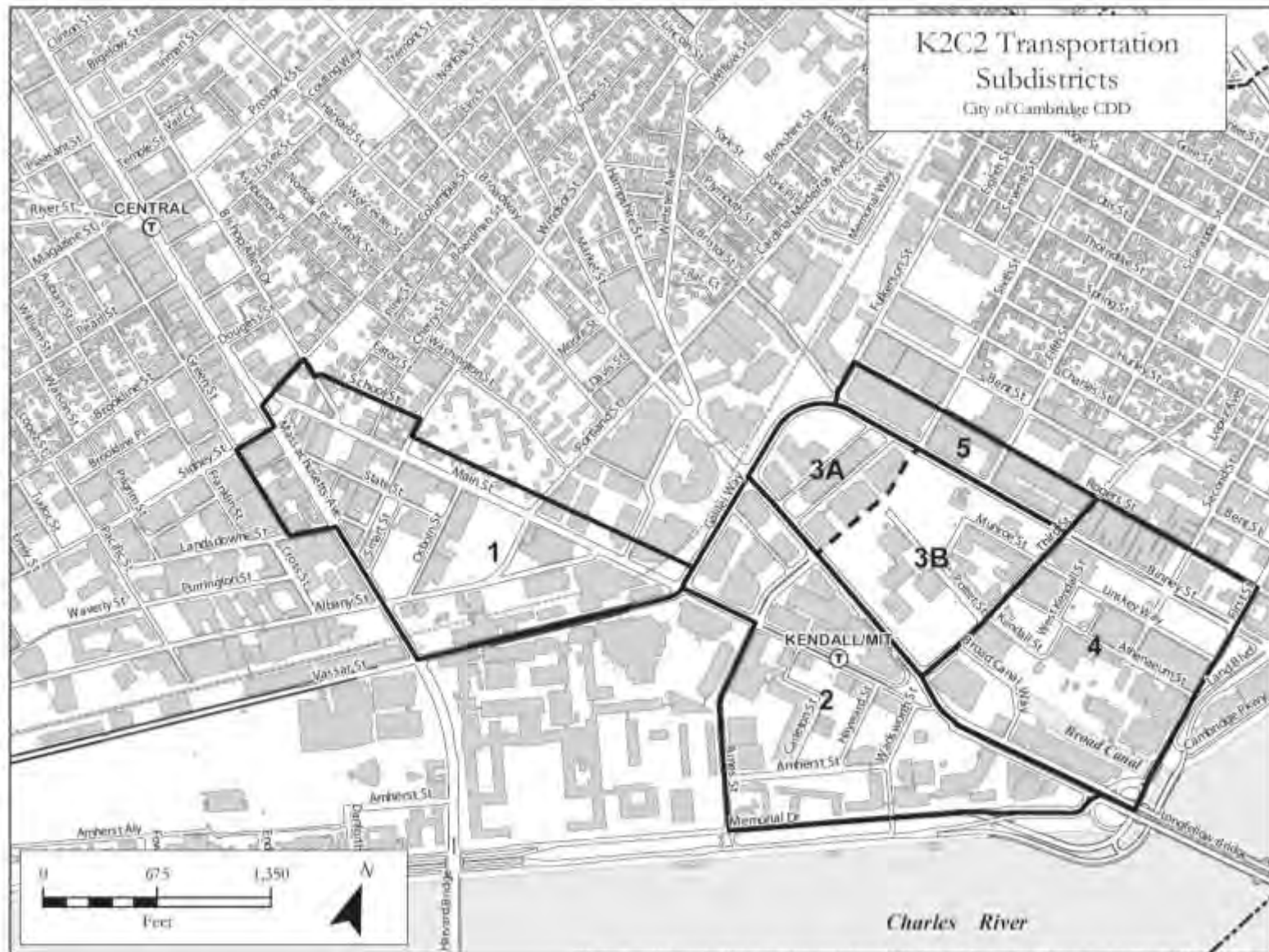
Intersections with 1,500 or fewer vehicles per hour considered to operate adequately, i.e. motorists will wait no more than two light cycles to get through the intersection.

When thresholds are exceeded, intersection operation starts to deteriorate exponentially.

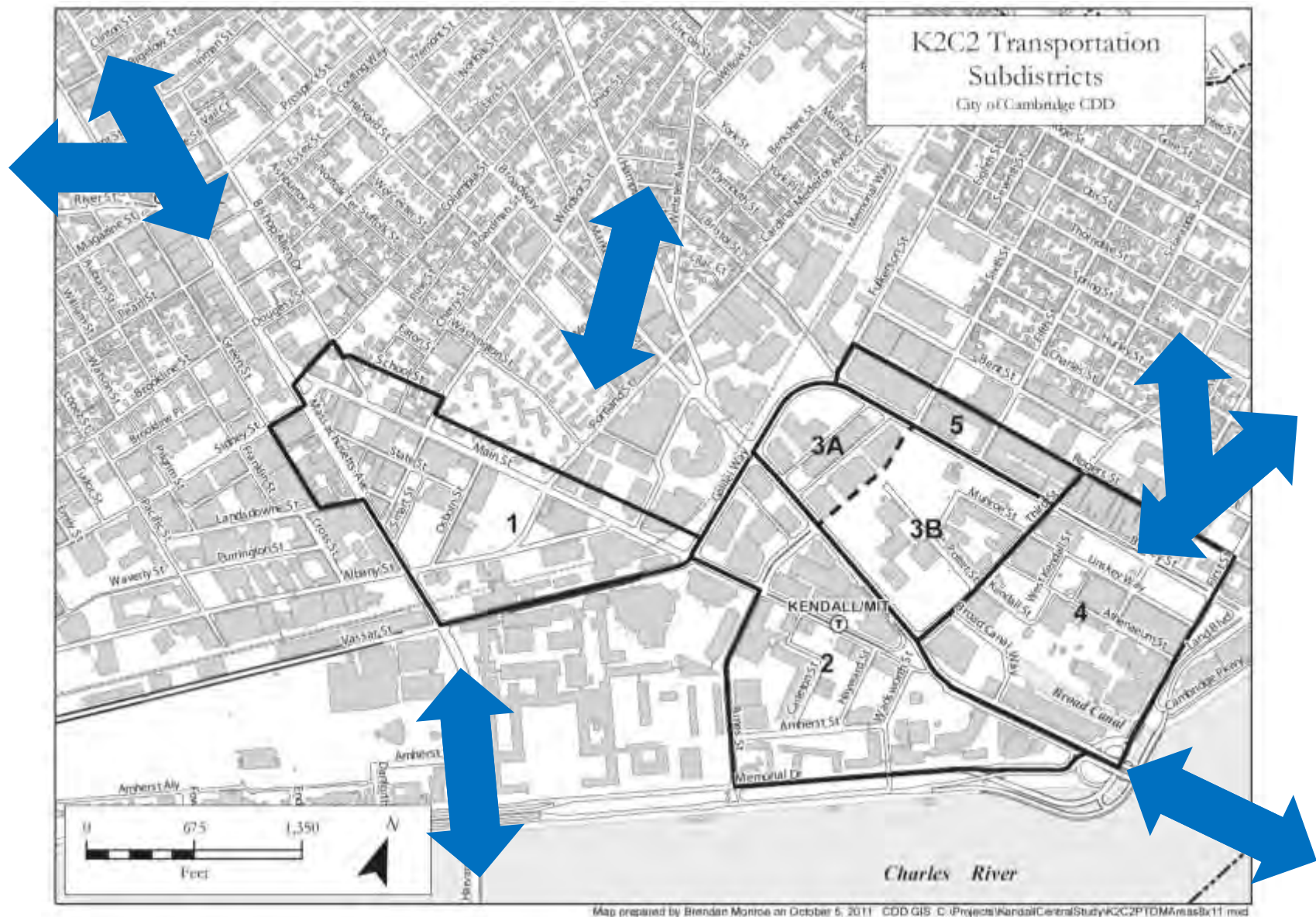
Intersections in Study Area



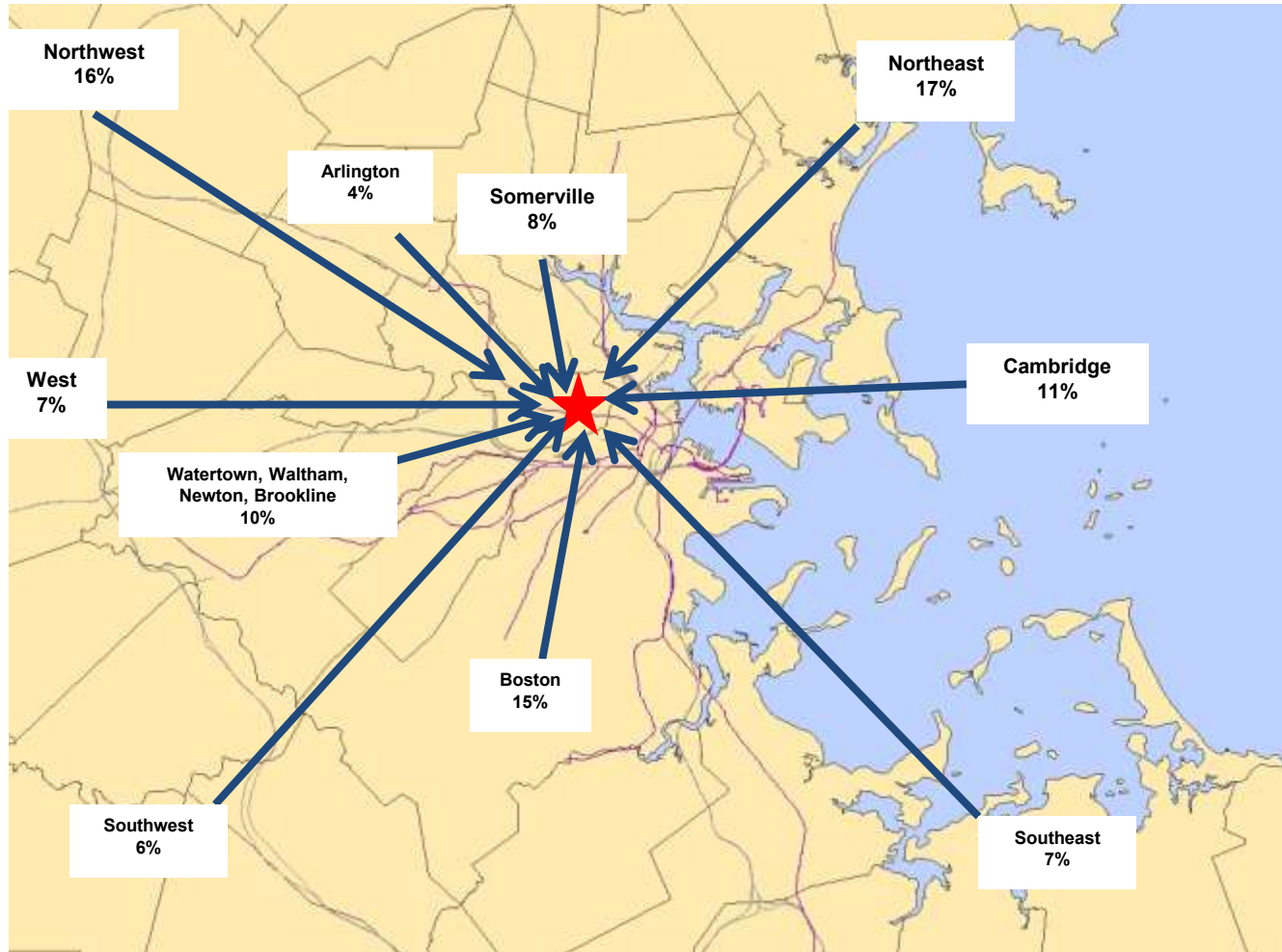
Sub-areas in Study Area



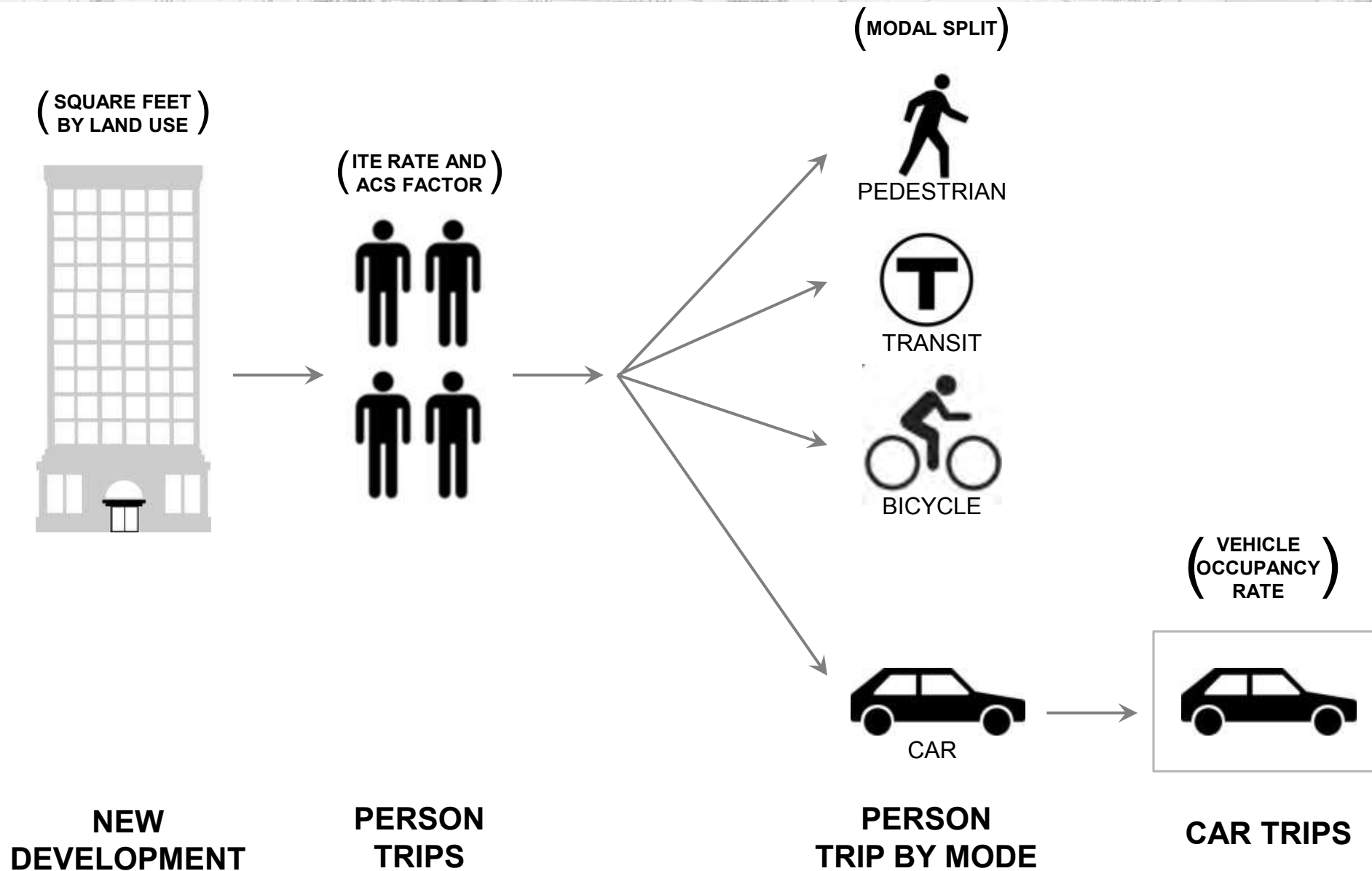
Trips for the Study Area



Commute to Work



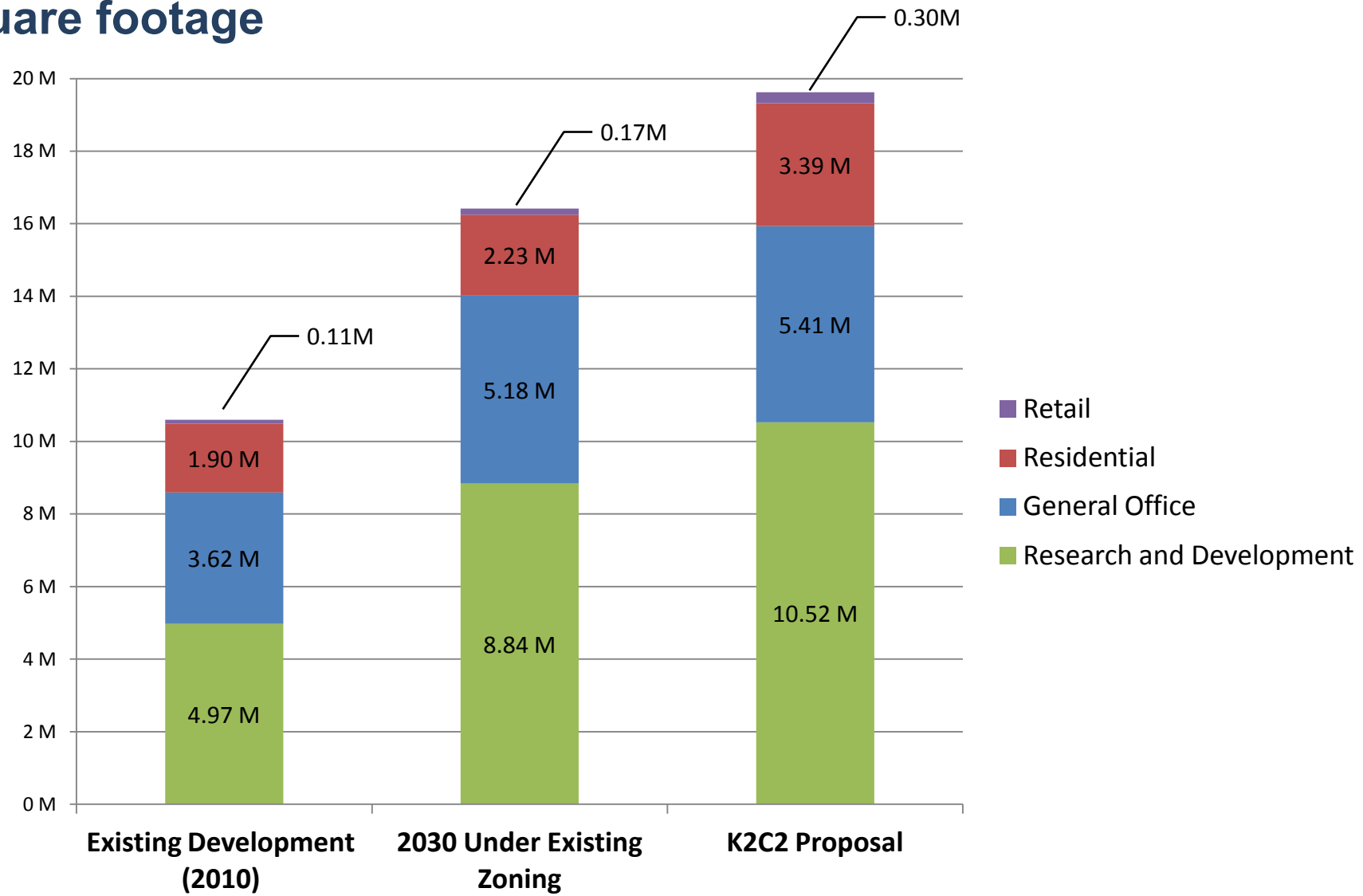
Calculating New Trips





K2C2 Development Scenarios

Square footage



Net New PM Person Trips

- Trips created by net new development

Retail	3.73
--------	-------------

General Office	1.49
----------------	-------------

Research & Development	1.07
------------------------	-------------

(new trips per 1000 sf of development)

Residential	0.62
-------------	-------------

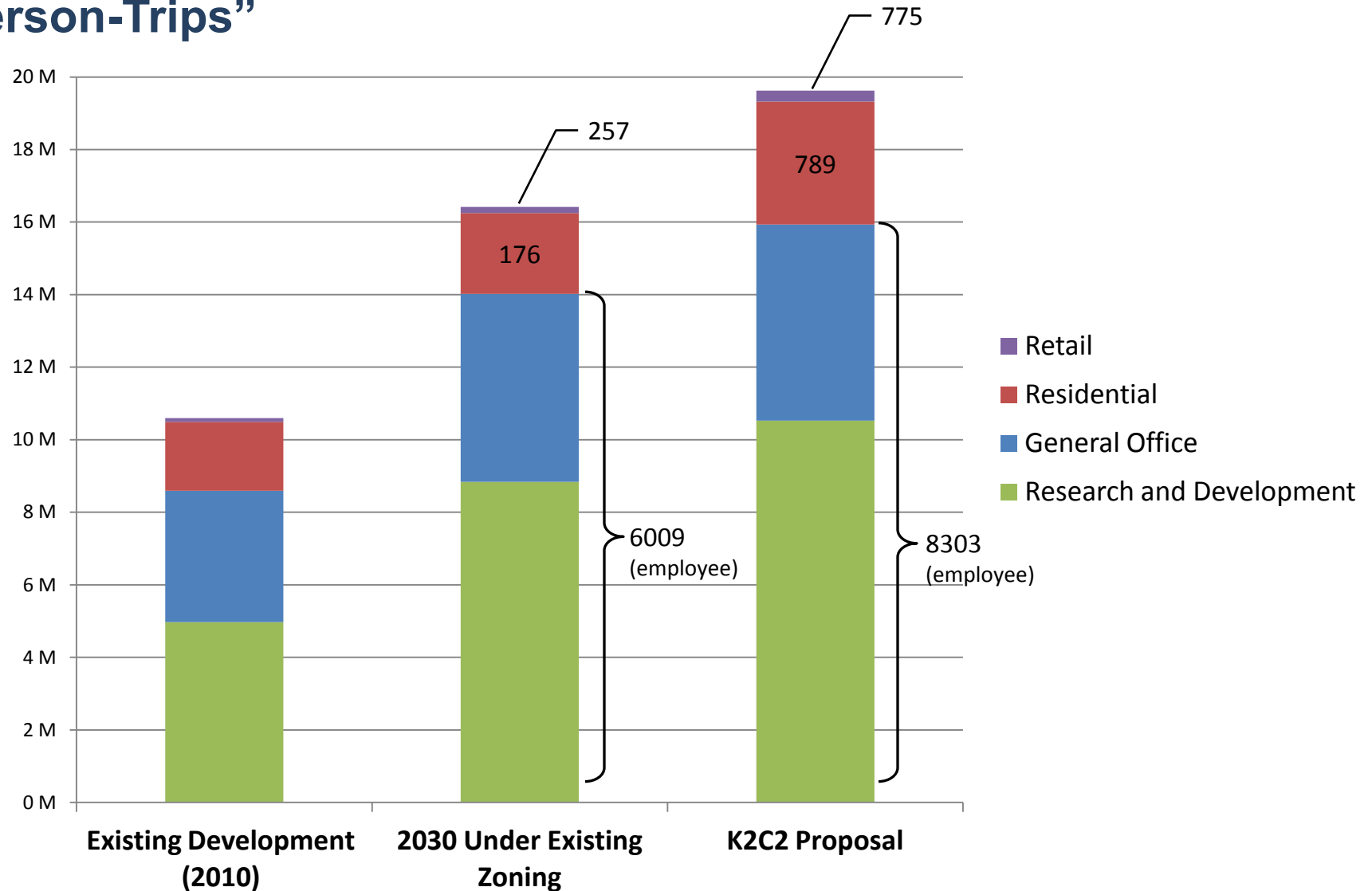
(new trips per “dwelling unit” added)

Average rates from the 8th Edition ITE Trip Generation manual

- ITE trips converted to “person-trips” using National ACS factor

2030 Net New Person Trips by Land Use

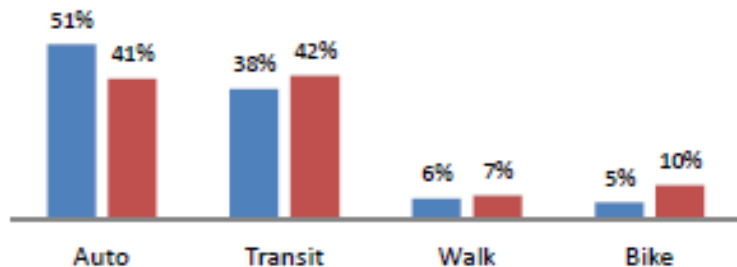
“Person-Trips”



Kendall Square Modal Shares by Land Use

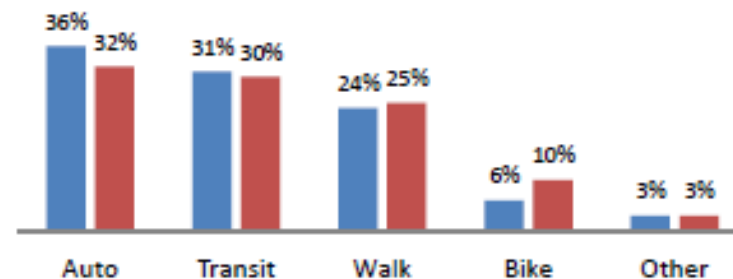
Office and R&D

■ Current ■ Enhanced TDM



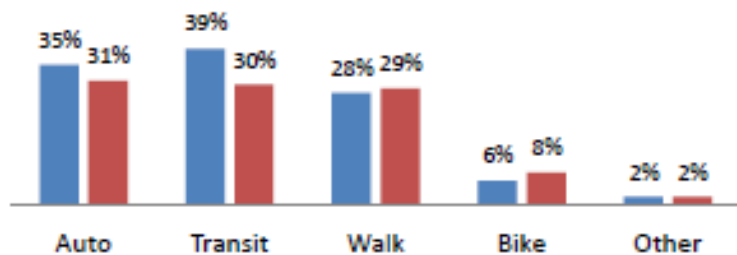
Residential

■ Current ■ Enhanced TDM



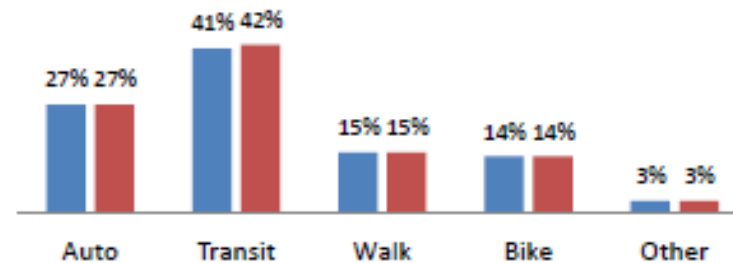
Retail

■ Current ■ Enhanced TDM



Academic/Institutional

■ Current ■ Enhanced TDM



2030 Net New Trips by Car – PM Peak Hour

Existing Zoning

Person-Trips

Residential	176
Employee	6,009
Retail	257
TOTAL	6,442

**35-51% of
Trips in Cars**

Vehicle occupancy
of 1.08-1.09

Car Trips

Residential	57
Employee	2,811
Retail	83
TOTAL	2,951

K2C2 Proposal

Person-Trips

Residential	789
Employee	8,303
Retail	775
TOTAL	9,867

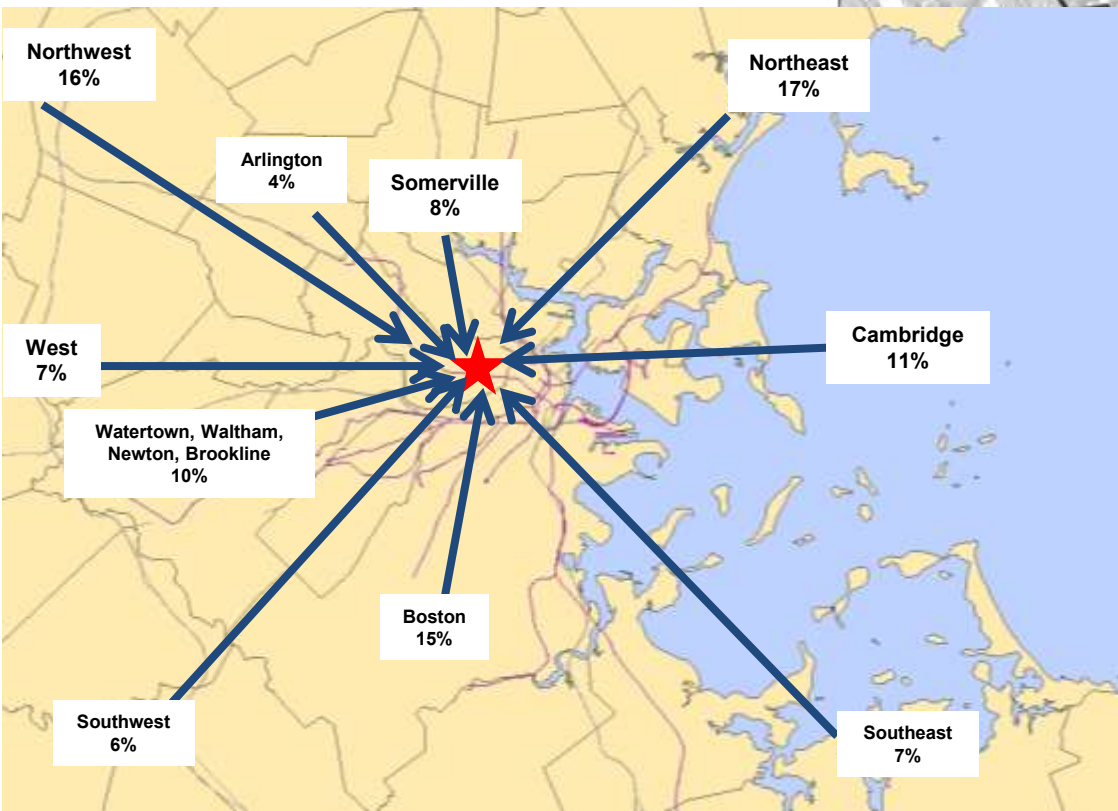
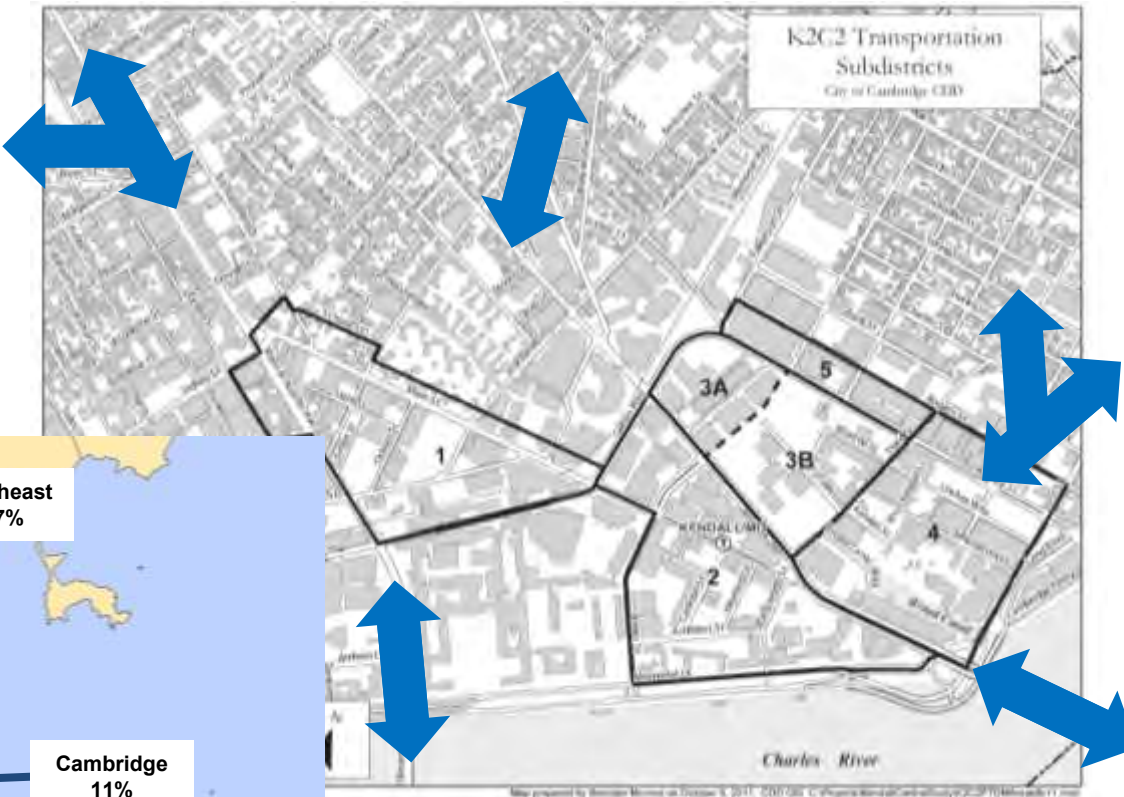
**35-51% of
Trips in Cars**

Vehicle occupancy
of 1.08-1.09

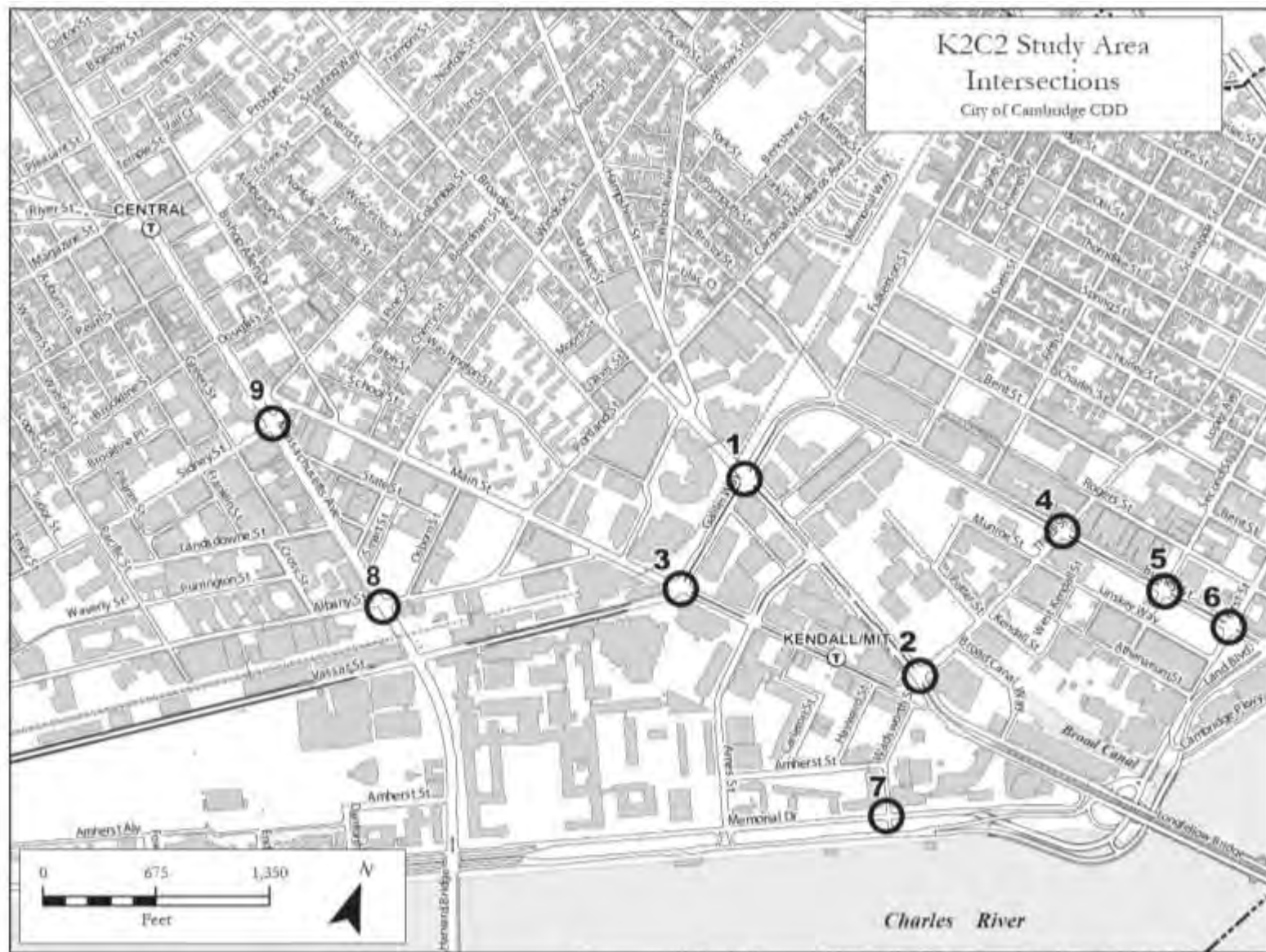
Car Trips

Residential	262
Employee	3,888
Retail	250
TOTAL	4,400

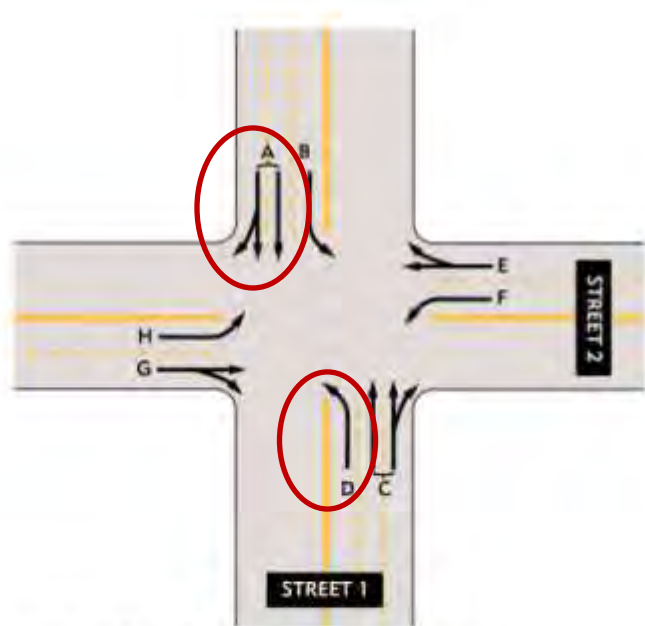
New Trips in the Study Area



Intersections in Study Area



Critical Sums Calculations

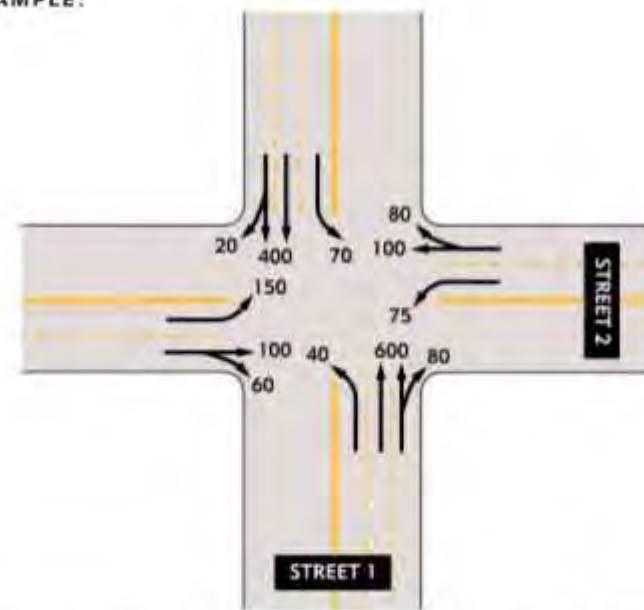


Street 1: $(A+2) + D$ or $(C+2) + B$, whichever is more

Street 2: $E + H$ or $G + F$, whichever is more

Critical Sum = Result of Street 1 + Street 2

EXAMPLE:

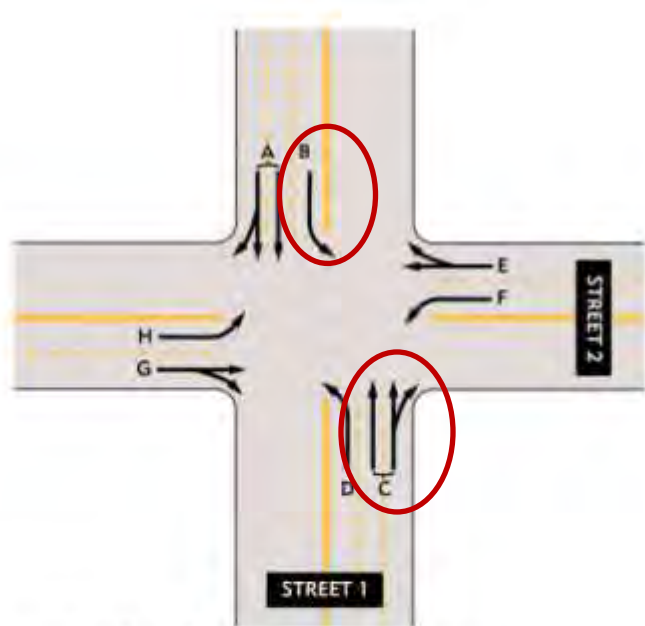


Street 1: $[(400 + 20)/2] + 40 = 250$ or $[(600 + 80)/2] + 70 = \boxed{410}$

Street 2: $(100 + 80) + 150 = \boxed{330}$ or $(100 + 60) + 75 = 235$

Critical Sum = $410 + 330 = 740$ vehicles

Critical Sums Calculations

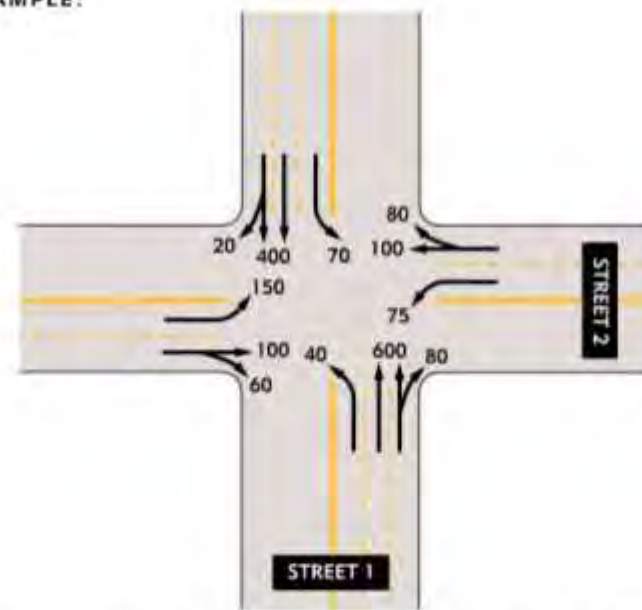


Street 1: $(A+2) + D$ or $(\underline{C+2}) + B$, whichever is more

Street 2: $E + H$ or $G + F$, whichever is more

Critical Sum = Result of Street 1 + Street 2

EXAMPLE:

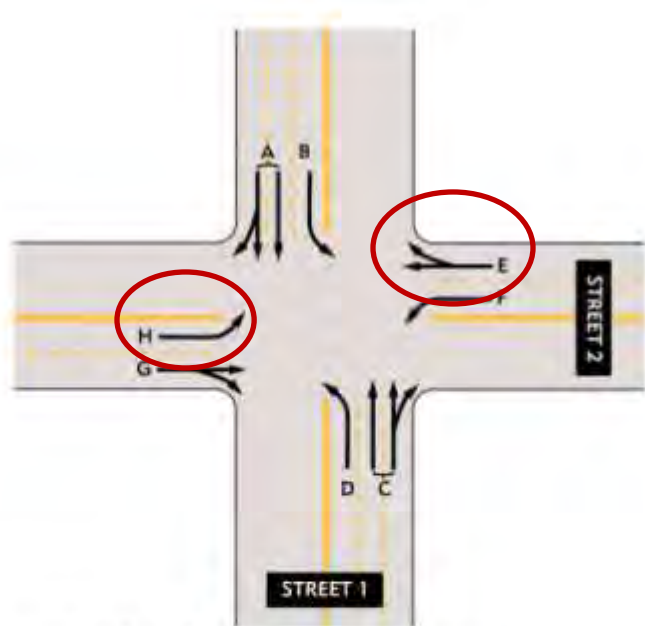


Street 1: $[(400 + 20)/2] + 40 = 250$ or $[(600 + 80)/2] + 70 = \underline{410}$

Street 2: $(100 + 80) + 150 = \underline{330}$ or $(100 + 60) + 75 = 235$

Critical Sum = $410 + 330 = 740$ vehicles

Critical Sums Calculations

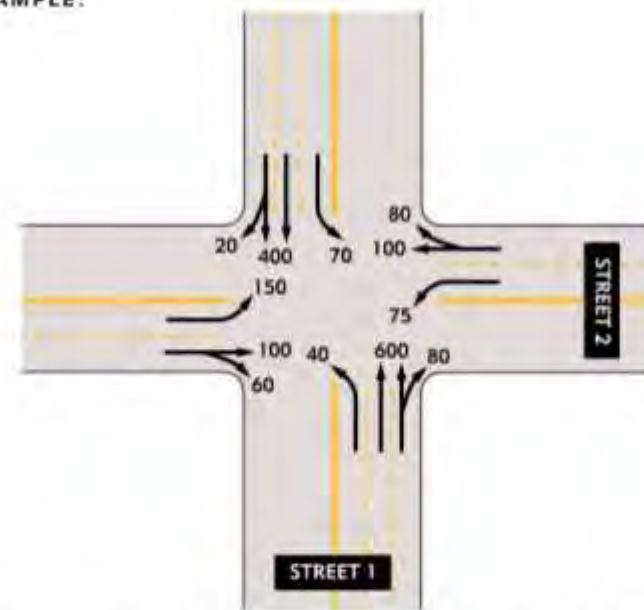


Street 1: $(A+2) + D$ or $(C+2) + B$, whichever is more

Street 2: $E + H$ or $G + F$, whichever is more

Critical Sum = Result of Street 1 + Street 2

EXAMPLE:

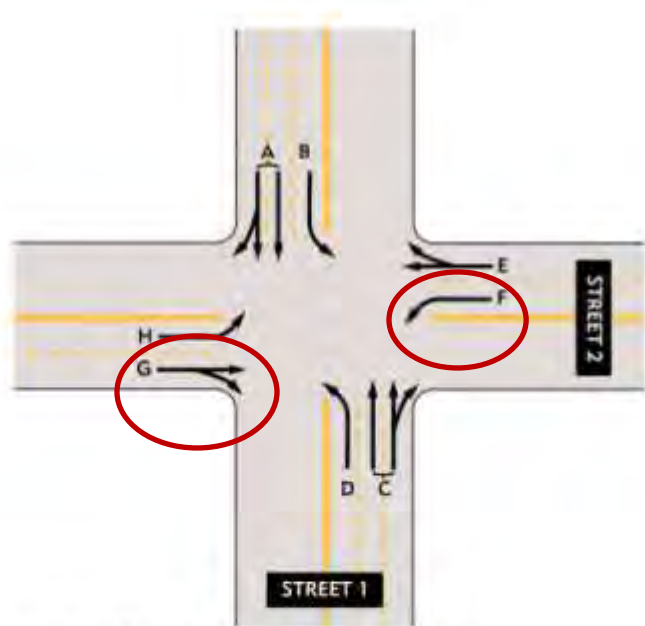


Street 1: $[(400 + 20)/2] + 40 = 250$ or $[(600 + 80)/2] + 70 = \boxed{410}$

Street 2: $(100 + 80) + 150 = \boxed{330}$ or $(100 + 60) + 75 = 235$

Critical Sum = $410 + 330 = 740$ vehicles

Critical Sums Calculations

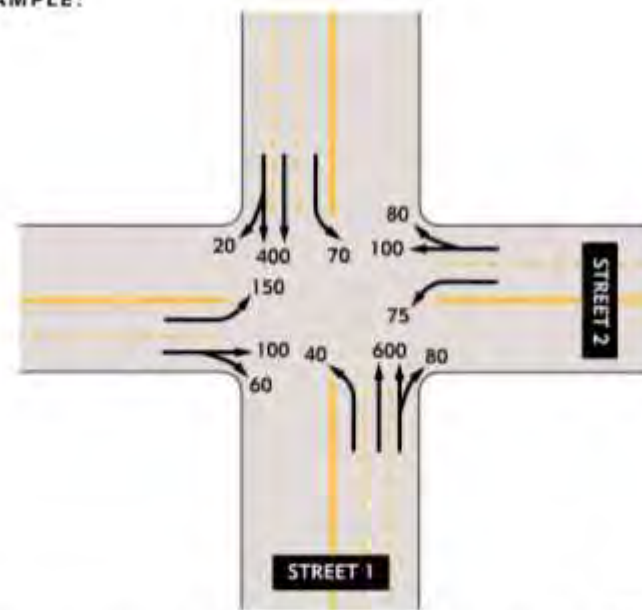


Street 1: $(A+2) + D$ or $(C+2) + B$, whichever is more

Street 2: $E + H$ or $G + F$, whichever is more

Critical Sum = Result of Street 1 + Street 2

EXAMPLE:



Street 1: $[(400 + 20)/2] + 40 = 250$ or $[(600 + 80)/2] + 70 = \boxed{410}$

Street 2: $(100 + 80) + 150 = \boxed{330}$ or $(100 + 60) + 75 = 235$

Critical Sum = $410 + 330 = 740$ vehicles

Critical Sums by Intersection ECaPS 1998 Counts

	ECaPS 1998 Existing	
	Volumes	Critical Sum
1. Broadway/Galilei	2800	1020
2. Broadway/Third	2280	1110
3. Main/Galilei/Vassar	1610	580
4. Binney/Third	2280	1200
5. Binney/First	1820	820
6. Binney/Land	3150	1080
7. Memorial Drive / Wadsworth	1270	700
8. Mass. Ave/Albany		
9. Main/Mass./Columbia/Sidney (Lafayette Sq.)		

- ECaPS report included 39 intersections
- 7 ECaPS intersections overlap with K2C2 study area intersections

Critical Sums by Intersection 2010 Counts

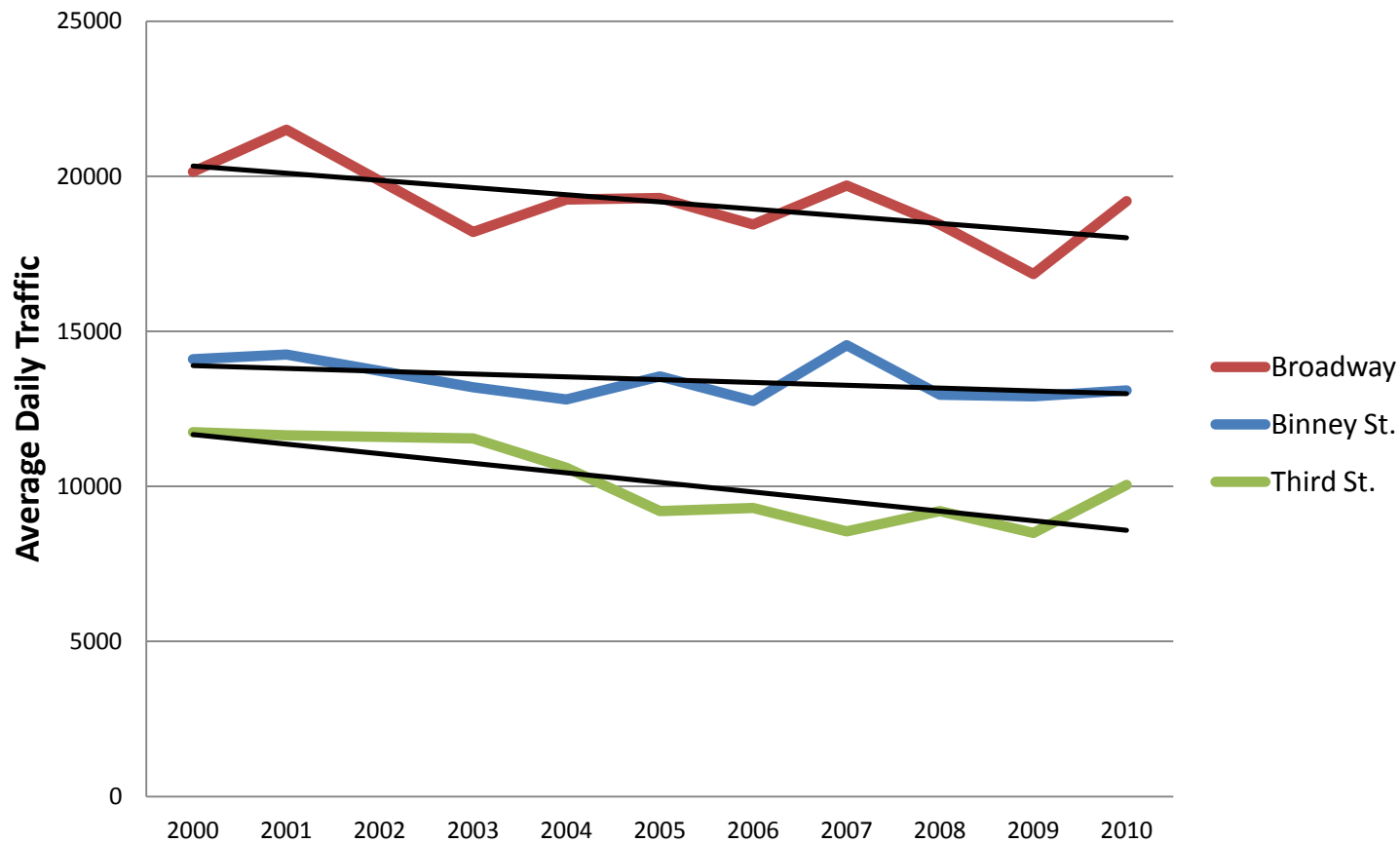
	ECaPS 1998 Existing		2010 Existing Conditions		
	Volumes	Critical Sum	Total Volume	Critical Sum	
1. Broadway/Galilei	2800	1020	2292	768	*
2. Broadway/Third	2280	1110	1964	1111	*
3. Main/Galilei/Vassar	1610	580	1764	711	
4. Binney/Third	2280	1200	2007	742	
5. Binney/First	1820	820	1311	590	
6. Binney/Land	3150	1080	2382	654	*
7. Memorial Drive / Wadsworth	1270	700	1361	680	
8. Mass. Ave/Albany			1850	807	
9. Main/Mass./Columbia/Sidney (Lafayette Sq.)			1460	762	

- Volumes generally decrease from 1998
- Three intersections with layout changes*



Traffic Trends

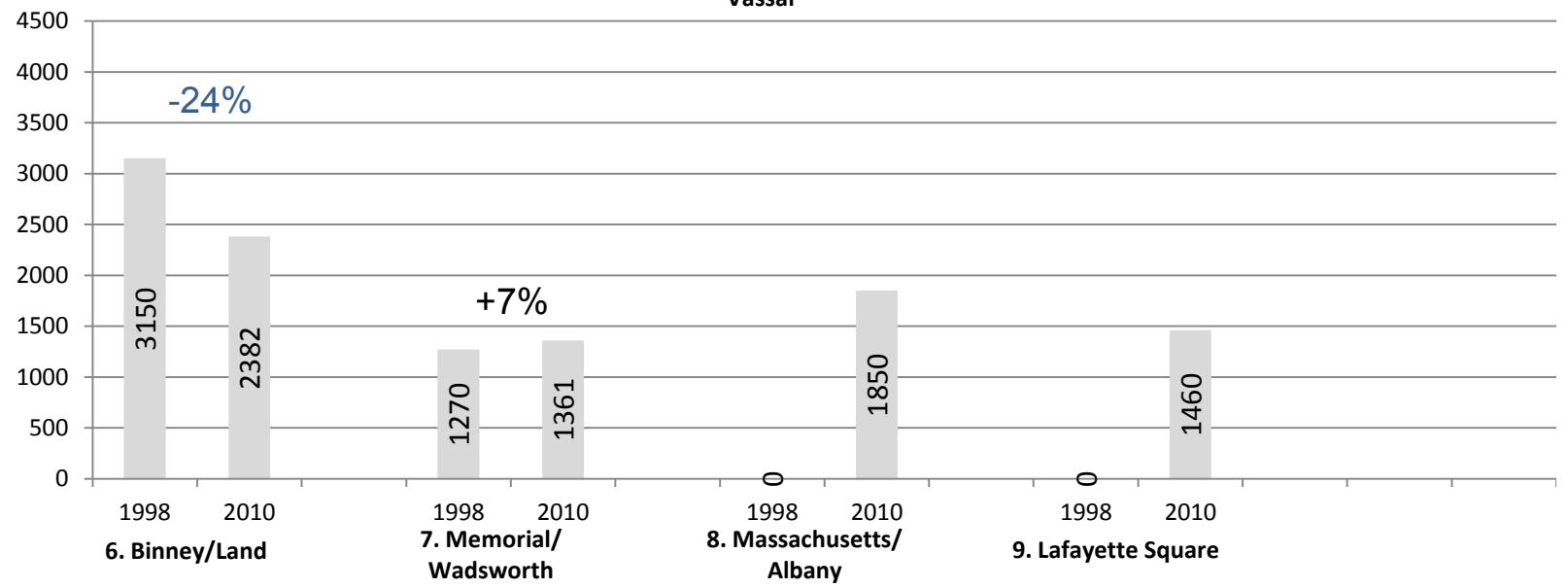
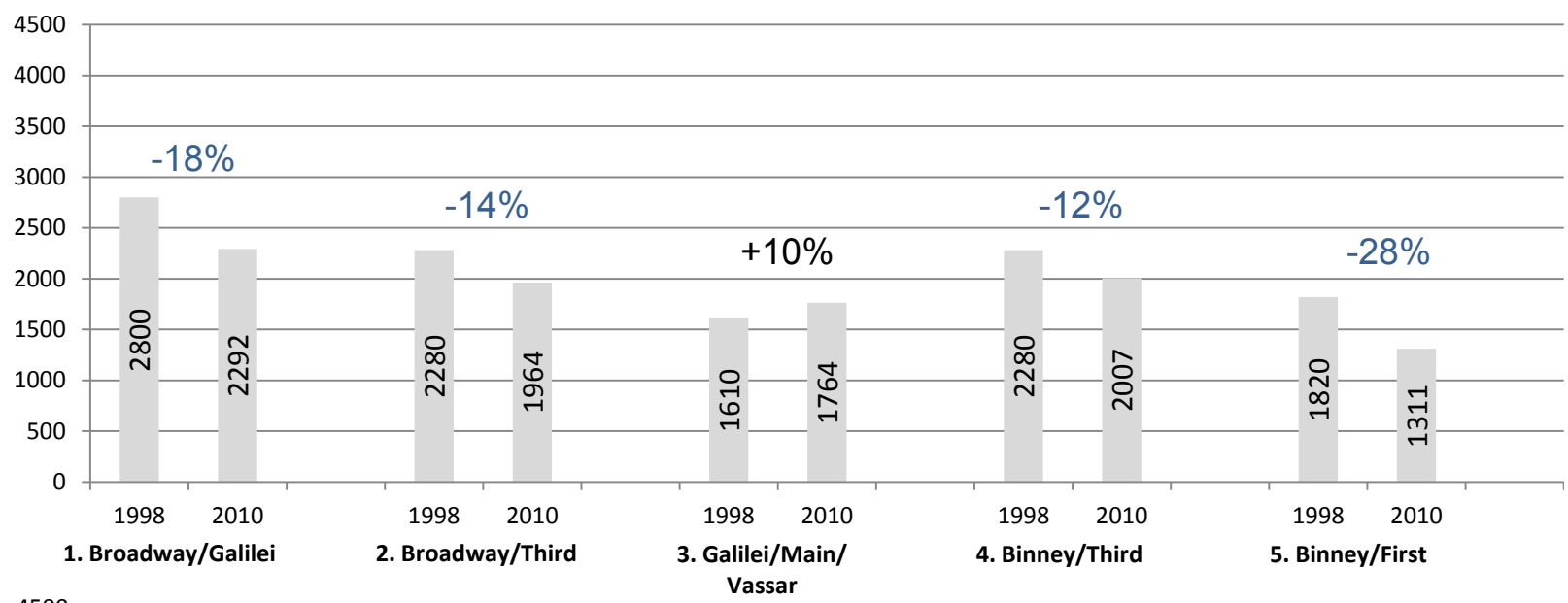
Kendall Square Average Daily Traffic with Trend Lines





PM Intersection Volume

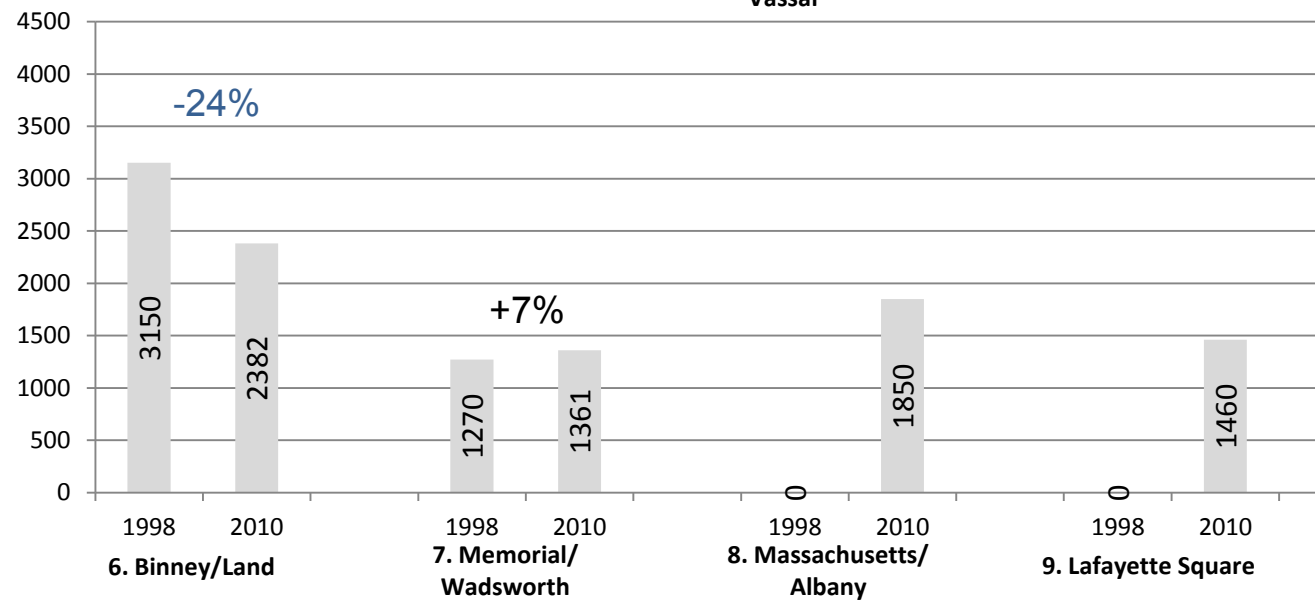
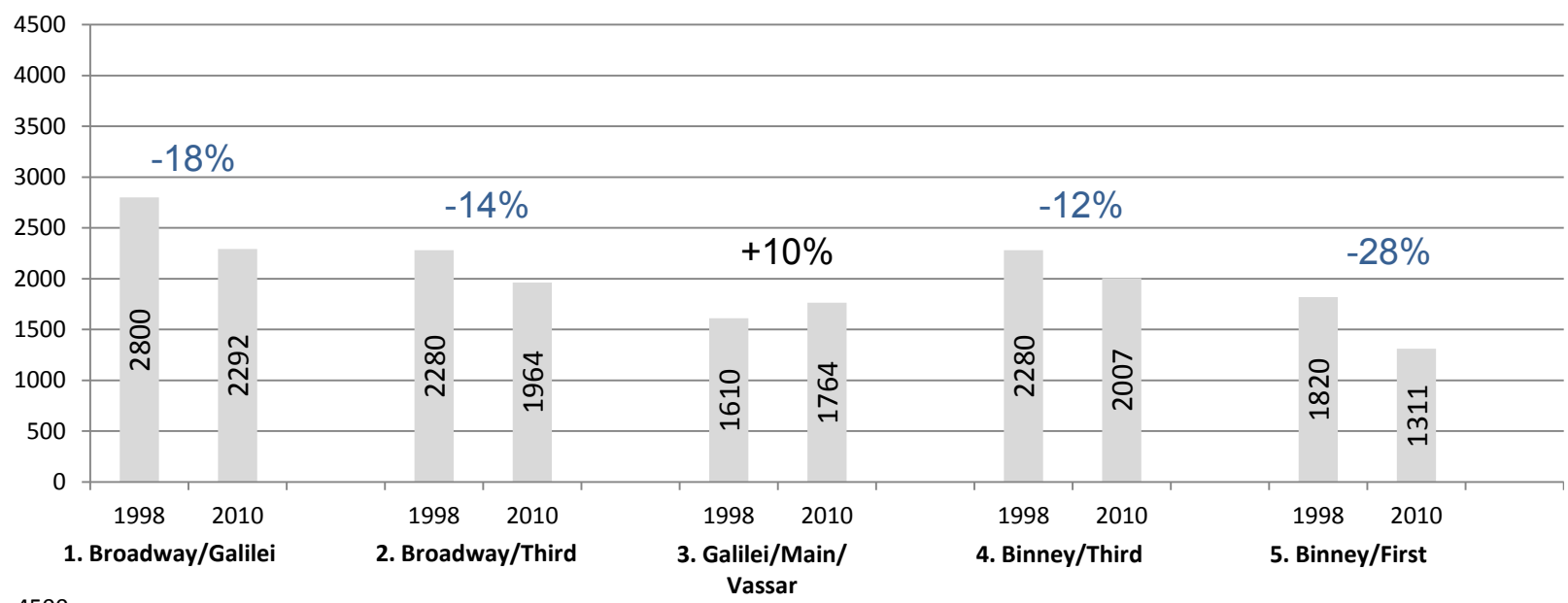
1998 ECaPS and 2010 K2C2





PM Intersection Volume

1998 ECaPS and 2010 K2C2



- Responsible growth
 - Growth policy
 - PTDM
 - Climate Action Plan
- Multi-modal approach
 - Ped/Bike Plan
 - Public Transportation

Critical Sums by Intersection ECaPS 2020

	ECaPS 1998 Existing		2010 Existing Conditions		ECaPS 2020		
	Volumes	Critical Sum	Total Volume	Critical Sum	Volumes	Critical Sum	
1. Broadway/Galilei	2800	1020	2292	768	4330	1670	*
2. Broadway/Third	2280	1110	1964	1111	3130	1510	*
3. Main/Galilei/Vassar	1610	580	1764	711	2620	1050	
4. Binney/Third	2280	1200	2007	742	3740	1690	*
5. Binney/First	1820	820	1311	590	3130	1260	
6. Binney/Land	3150	1080	2382	654	4540	2010	*
7. Memorial Drive / Wadsworth	1270	700	1361	680	1460	780	
8. Mass. Ave/Albany			1850	807			
9. Main/Mass./Columbia/Sidney (Lafayette Sq.)			1460	762			

- ECaPS 2020 projected 4 intersections exceed 1,500 Critical Movements threshold in 2020*
 - 55% auto trips vs. 51% today for employees
 - 2010 existing conditions: 0 intersections exceed threshold

Critical Sums by Intersection 2030 Existing Zoning

	ECaPS 1998 Existing		2010 Existing Conditions		ECaPS 2020		2030 Buildout Existing Zoning	
	Volumes	Critical Sum	Total Volume	Critical Sum	Volumes	Critical Sum	Total Volume	Critical Sum
1. Broadway/Galilei	2800	1020	2292	768	4330	1670	2692	896
2. Broadway/Third	2280	1110	1964	1111	3130	1510	2400	1325
3. Main/Galilei/Vassar	1610	580	1764	711	2620	1050	2144	955
4. Binney/Third	2280	1200	2007	742	3740	1690	2594	980
5. Binney/First	1820	820	1311	590	3130	1260	1439	654
6. Binney/Land	3150	1080	2382	654	4540	2010	3019	917
7. Memorial Drive / Wadsworth	1270	700	1361	680	1460	780	1638	802
8. Mass. Ave/Albany			1850	807			2122	1017
9. Main/Mass./Columbia/Sidney (Lafayette Sq.)			1460	762			1879	1025

- Total intersection volumes increase 10-29% (avg 22%)
- Broadway/Third closest to threshold

Critical Sums by Intersection 2030 K2C2 Proposal

	ECaPS 1998 Existing		2010 Existing Conditions		ECaPS 2020		2030 Buildout Existing Zoning		2030 Buildout K2C2	
	Volumes	Critical Sum	Total Volume	Critical Sum	Volumes	Critical Sum	Total Volume	Critical Sum	Total Volume	Critical Sum
1. Broadway/Galilei	2800	1020	2292	768	4330	1670	2692	896	2882	952
2. Broadway/Third	2280	1110	1964	1111	3130	1510	2400	1325	3106	1710
3. Main/Galilei/Vassar	1610	580	1764	711	2620	1050	2144	955	2424	1155
4. Binney/Third	2280	1200	2007	742	3740	1690	2594	980	3004	1136
5. Binney/First	1820	820	1311	590	3130	1260	1439	654	1520	694
6. Binney/Land	3150	1080	2382	654	4540	2010	3019	917	3211	991
7. Memorial Drive / Wadsworth	1270	700	1361	680	1460	780	1638	802	1687	812
8. Mass. Ave/Albany			1850	807			2122	1017	2158	1045
9. Main/Mass./Columbia/Sidney (Lafayette Sq.)			1460	762			1879	1025	2146	1143

Intersections
over 1500:

0

4

0

1

- Total intersection volumes increase 16-58% (avg 35%)
- Broadway/Third exceeds threshold (1,710)

2030 Net New Trips by Car with enhanced TDM

Person-Trips

Residential	789
Employee	8,303
Retail	775
TOTAL	9,867

**35-51% of
Trips in Cars**

Vehicle occupancy
of 1.08-1.09

Car Trips

Residential	262
Employee	3,888
Retail	250
TOTAL	4,400

**10% Fewer
Car Trips**

(-817 cars)

Car Trips (enhanced TDM)

Residential	234
Employee	3,126
Retail	223
TOTAL	3,583

Current Kendall TDM Measures & Participation*

Measure	%
Rideshare matching	
Secure bike storage	
Transit Subsidy	
Free Shuttle	
Emergency Ride Home	
Lockers	
Charles River TMA Membership	
Showers	
MBTA passes sold on-site	
Trans info new employee packet/training	

Measure	%
HOV Parking Spaces	
Info on Website	
Newsletter	
Annual Trans Fair	
EZRIDE contribution	
Flexible Work Hours	
Employees Charged for Parking(#)	
Carpool incentive	
Allow telecommuting	
Bike incentives	

Measure	%
Parking Cash-out (#)	
Vanpool incentives	
Transit accessibility advertised in materials	
On-Site amenities	
Car-Share Vehicle	
Toll Free # for shuttle	
Commuter Check	

*Among Businesses/Office Building Owners with PTDM Plans or Special Permits



Cambridge's PTDM program is a national best practice



Cambridge businesses & residences participate in many TDM measures



High participation rates in nearly half of all available programs



Low participation rates in some of the most effective TDM measures (cost more to support)



urban design/planning study for
the **central** and **kendall square area**

Critical Sums by Intersection

	2010 Existing Conditions		2030 Buildout Existing Zoning		2030 Buildout K2C2		2030 Buildout K2C2 with Enhanced TDM	
	Total Volume	Critical Sum	Total Volume	Critical Sum	Total Volume	Critical Sum	Total Volume	Critical Sum
1. Broadway/Galilei	2292	768	2692	896	2882	952	2774	918
2. Broadway/Third	1964	1111	2400	1325	3106	1710	2893	1599
3. Main/Galilei/Vassar	1764	711	2144	955	2424	1155	2302	1072
4. Binney/Third	2007	742	2594	980	3004	1136	2820	1061
5. Binney/First	1311	590	1439	654	1520	694	1487	678
6. Binney/Land	2382	654	3019	917	3211	991	3057	923
7. Memorial Drive / Wadsworth	1361	680	1638	802	1687	812	1625	787
8. Mass. Ave/Albany	1850	807	2122	1017	2158	1045	2098	998
9. Main/Mass./Columbia /Sidney (Lafayette Sq.)	1460	762	1879	1025	2146	1143	2017	1071

Critical Sums by Intersection

	2010 Existing Conditions		2030 Buildout Existing Zoning		2030 Buildout K2C2		2030 Buildout K2C2 with Enhanced TDM	
	Total Volume	Critical Sum	Total Volume	Critical Sum	Total Volume	Critical Sum	Total Volume	Critical Sum
1. Broadway/Galilei	2292	768	2692	896	2882	952	2774	918
2. Broadway/Third	1964	1111	2400	1325	3106	1710	2893	1599
3. Main/Galilei/Vassar	1764	711	2144	955	2424	1155	2302	1072
4. Binney/Third	2007	742	2594	980	3004	1136	2820	1061
5. Binney/First	1311	590	1439	654	1520	694	1487	678
6. Binney/Land	2382	654	3019	917	3211	991	3057	923
7. Memorial Drive / Wadsworth	1361	680	1638	802	1687	812	1625	787
8. Mass. Ave/Albany	1850	807	2122	1017	2158	1045	2098	998
9. Main/Mass./Columbia /Sidney (Lafayette Sq.)	1460	762	1879	1025	2146	1143	2017	1071

Preferred Scenario

Conclusion

- Critical sums is a planning tool
- Used to compare future build-out scenarios
- Future development projects subject to:
 - Traffic study/traffic mitigation requirements in Zoning Ordinance
 - PTDM Ordinance

