A NEW BIKE ROUTE BETWEEN MIT AND HARVARD

SEMINAR PROJECT

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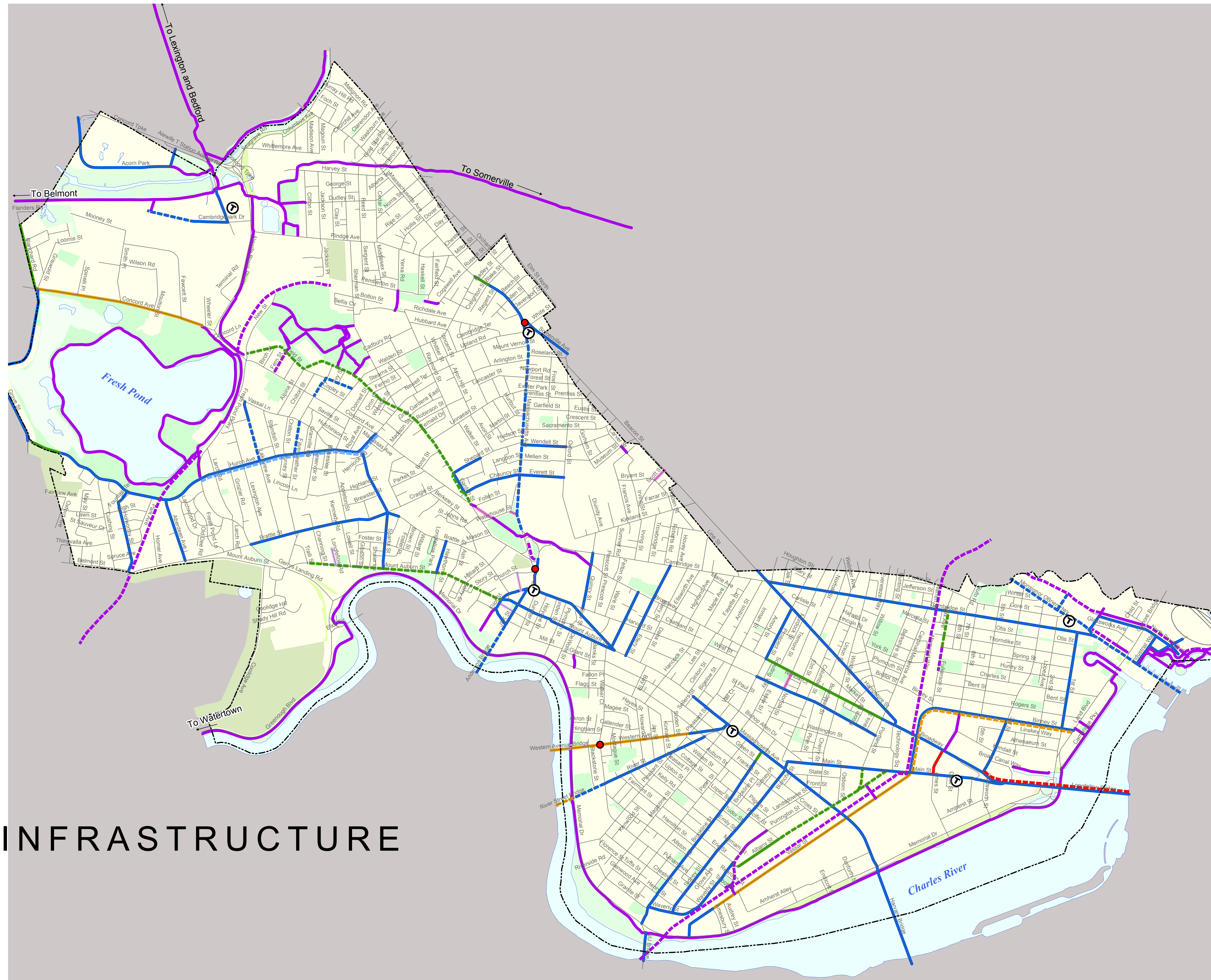
MANOS SARATSIS, YUE SHAO, FENG SHEN, TOON VIROCHPOKA, LIUWEI ZHAO

art credit: Boston Complete Streets, Boston Transportation Department. (manipulated) bicycle infrastructure

underdeveloped



EAST CAMBRIDGE INFRASTRUCTURE

Source: City of Cambridge

existing bicycle facilities

- shared-use path
- cycle track
- protected bike lane
- bike lane
- contraflow bike lane
- shared-lane marking
- shared-street

BICYCLE COUNT STATIONS

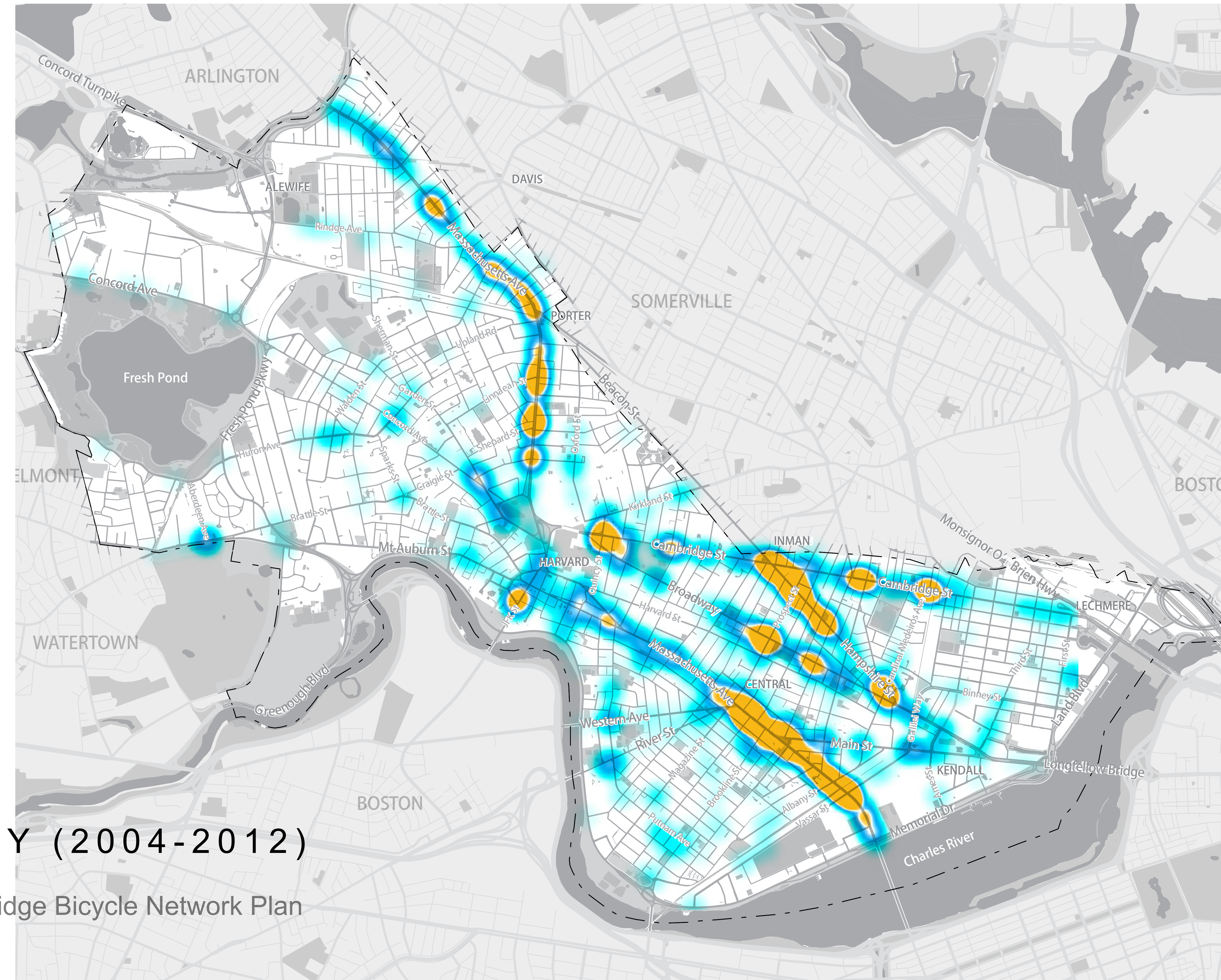
bicyclists counted by year

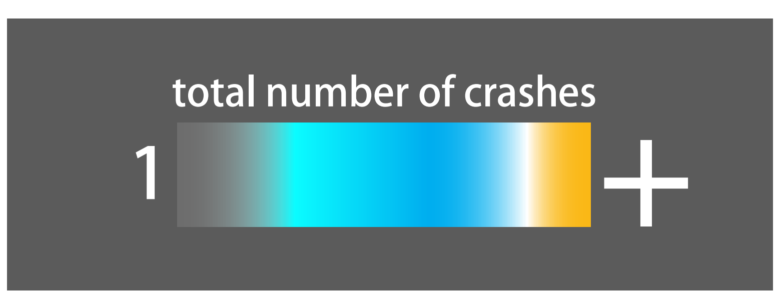
+

2004 2005 2006 2008 2010 2012

BICYCLE COUNT

Source: City of Cambridge: Cambridge Bicycle Network Plan





CRASH FREQUENCY (2004-2012)

Source: City of Cambridge: Cambridge Bicycle Network Plan

1 Comfortable for users from ages 8 to 80

2 Comfortable for adults who don't often ride a bicycle

3 Tolerable for adults who are comfortable in shared traffic but prefer separation from vehicles

4 Tolerable for adults comfortable in shared traffic without separation

5 Intolerable even for most experienced adults, often perceived as unrideable

EXISTING CONDITIONS ANALYSIS

Bicycle Level of Comfort

1 2 3 4 5

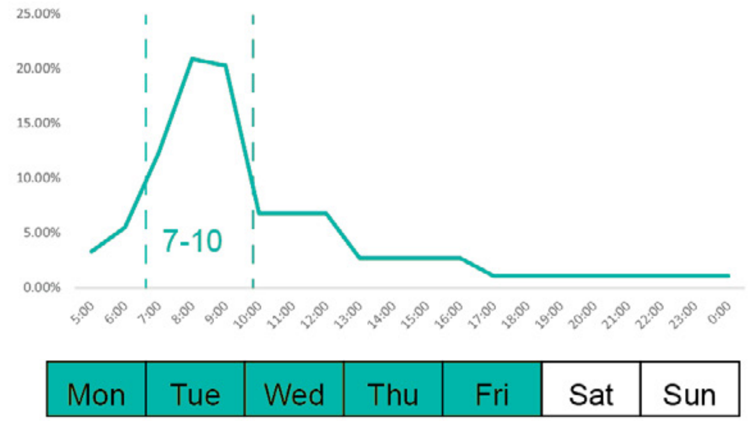
high comfort — low comfort

CAMBRIDGE BICYCLE COMFORT MAP

Source: City of Cambridge

7.8% of work force in Camridge bicycle to work*

Commute to Work



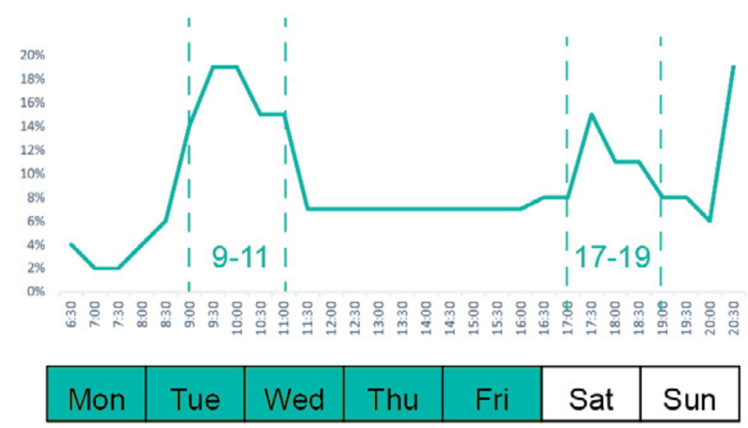
65% of cyclists in Cambridge take shopping trips on bikes***

Run Errands

14% of MIT students & faculty bicycle to school**

30% of student population in Cambridge bike****

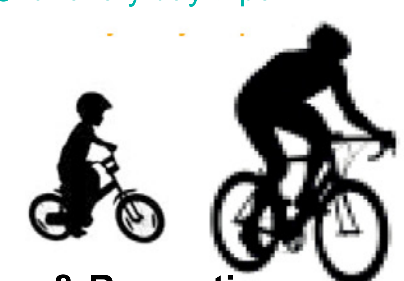
Commute to School

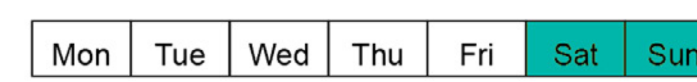


Shopping, leisure, personal business, recreation -

80% of every day trips***

Leisure & Recreation

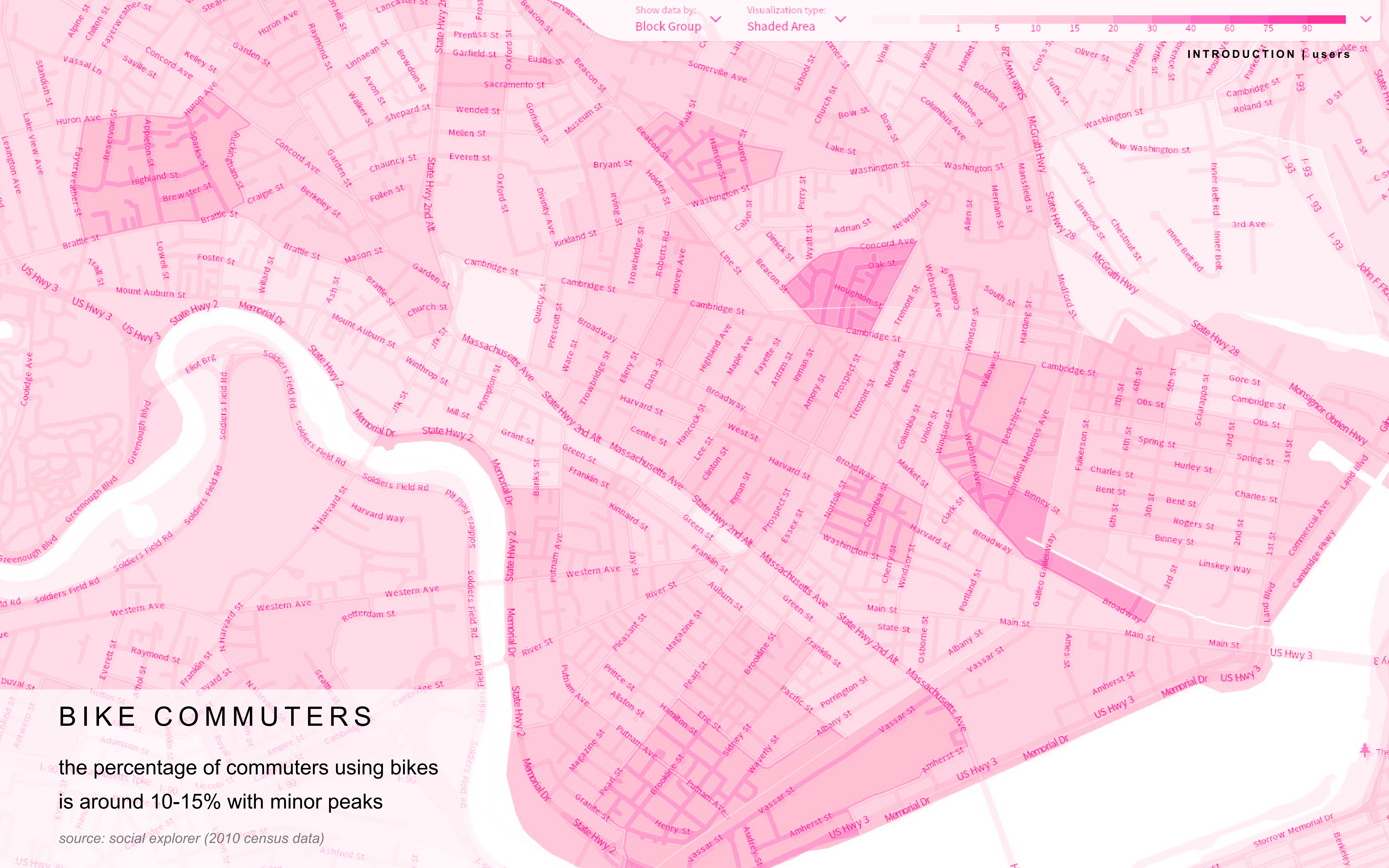




PERSONAS AND BIKING ACTIVITY

4 personas with distinctive activity patterns

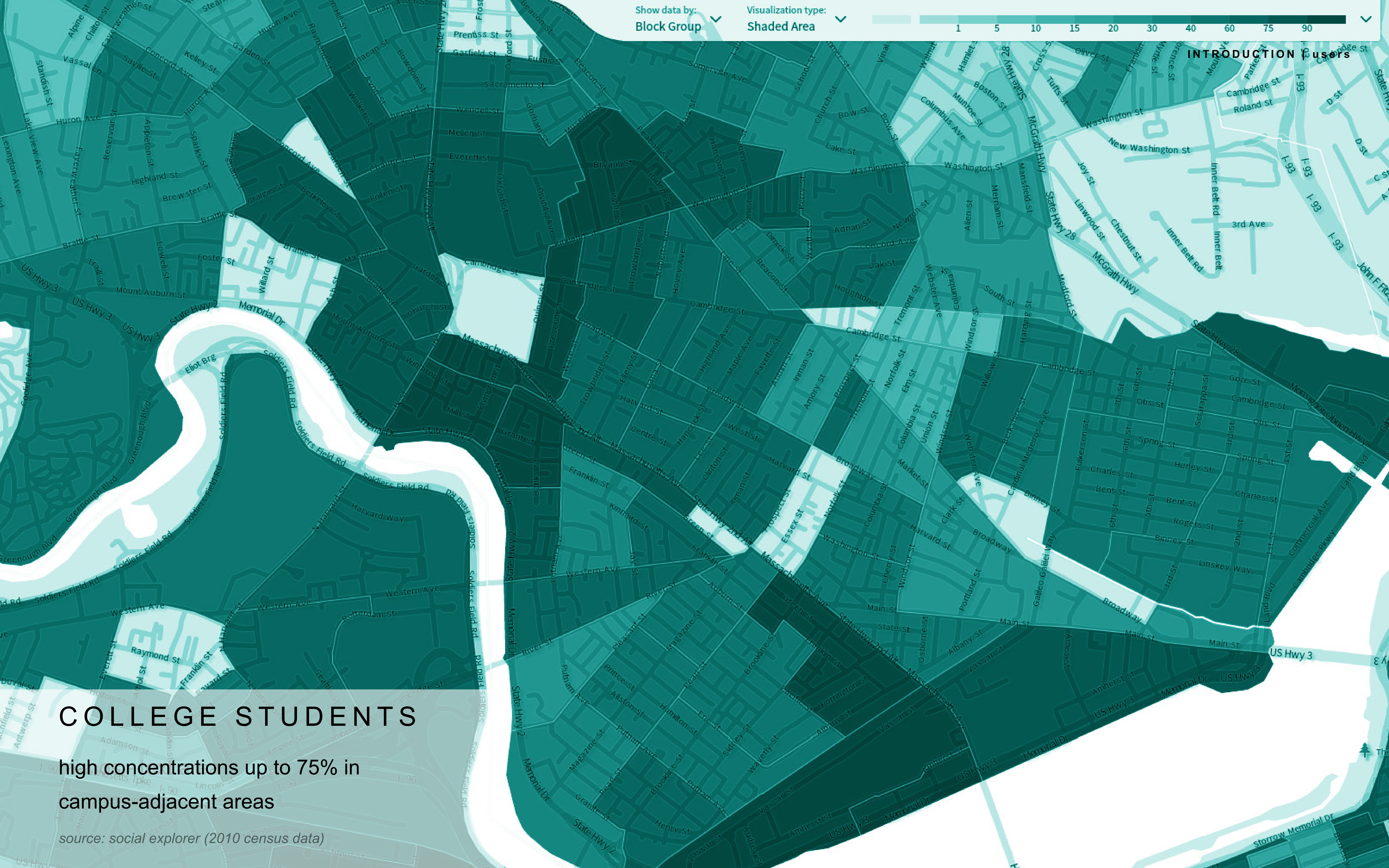
during the week and the day



BIKE COMMUTERS

the percentage of commuters using bikes is around 10-15% with minor peaks

source: social explorer (2010 census data)



COLLEGE STUDENTS

high concentrations up to 75% in campus-adjacent areas

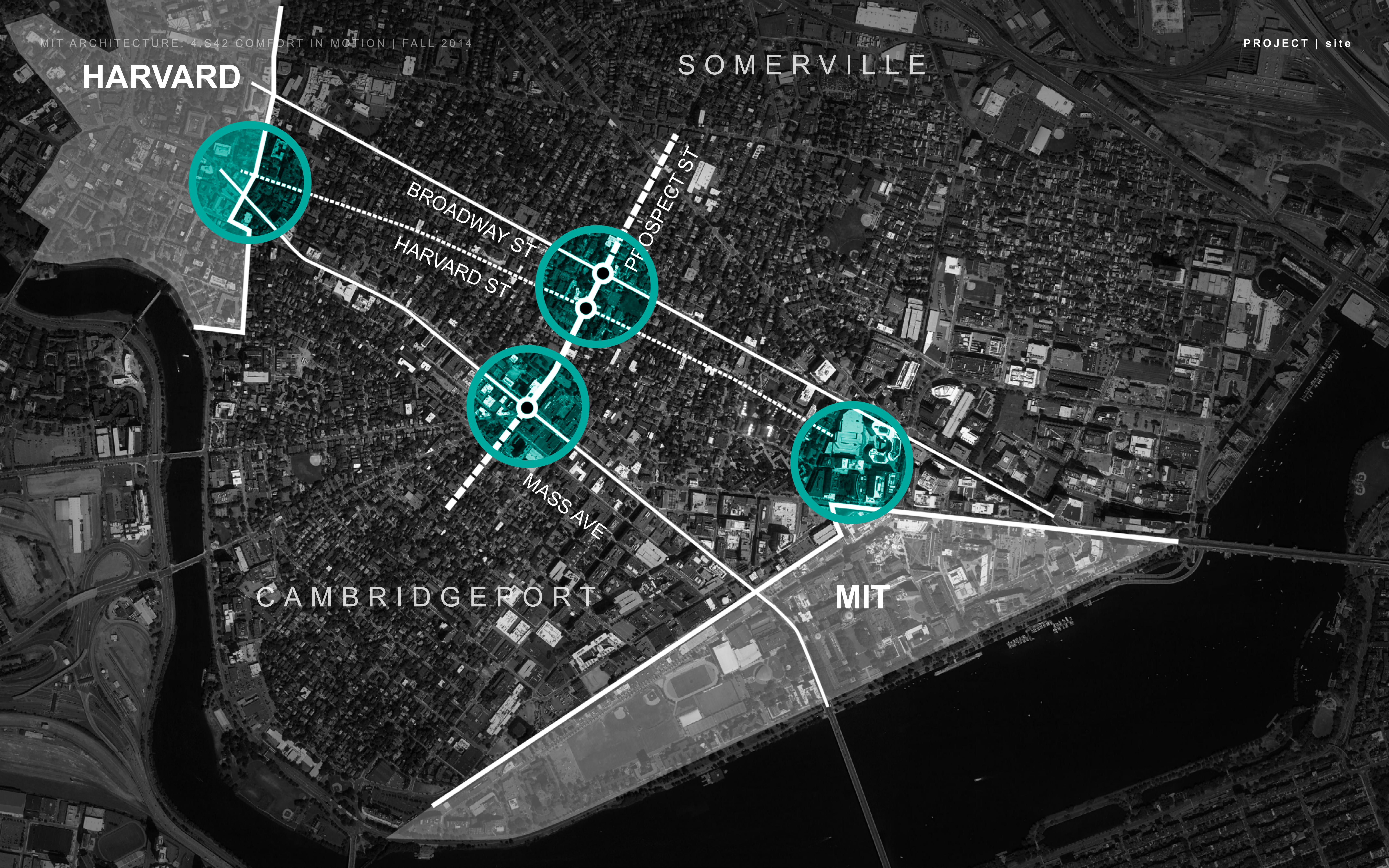
source: social explorer (2010 census data)

01 terrain

TERRAIN

slopes and difficulty to bike


HARVARD
SOMERVILLE
BROADWAY ST
PROSPECT ST
HARVARD ST
MASS AVE
CAMBRIDGEPORT
MIT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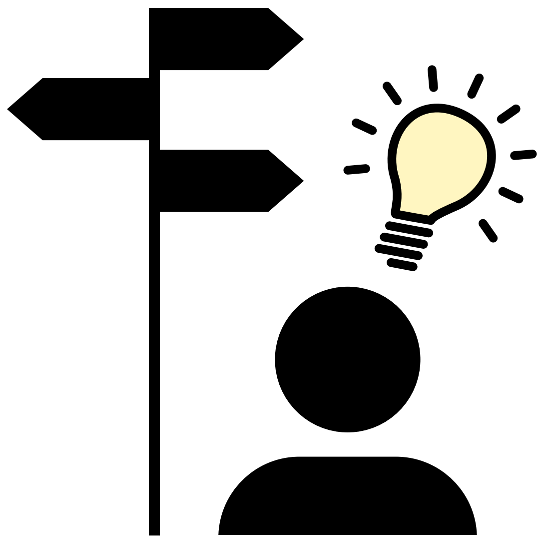
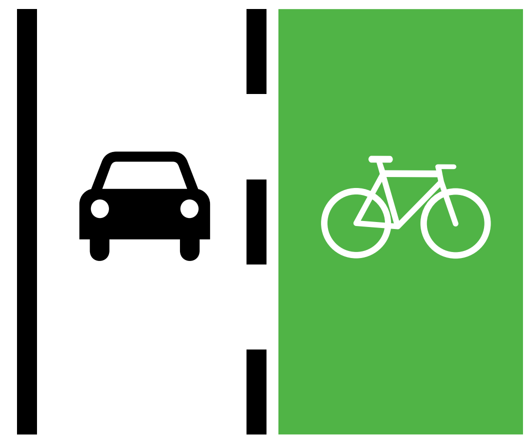
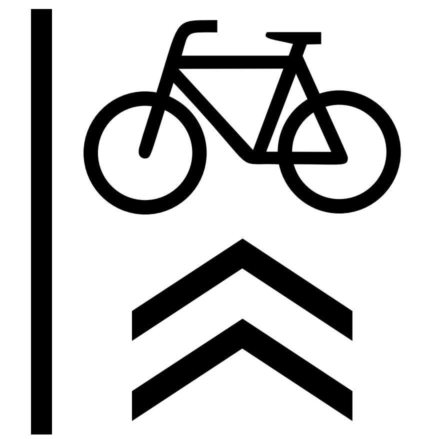


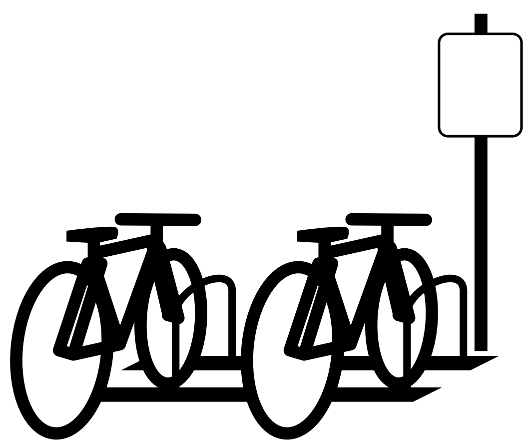
Clearer Signage



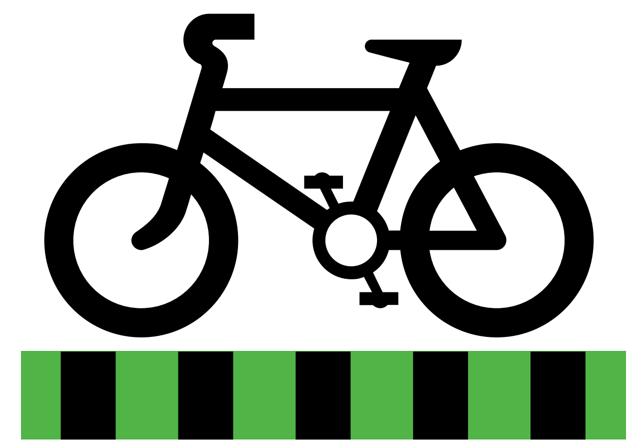
Protected Bike Lane



Wider Bike Lane



Bike Racks

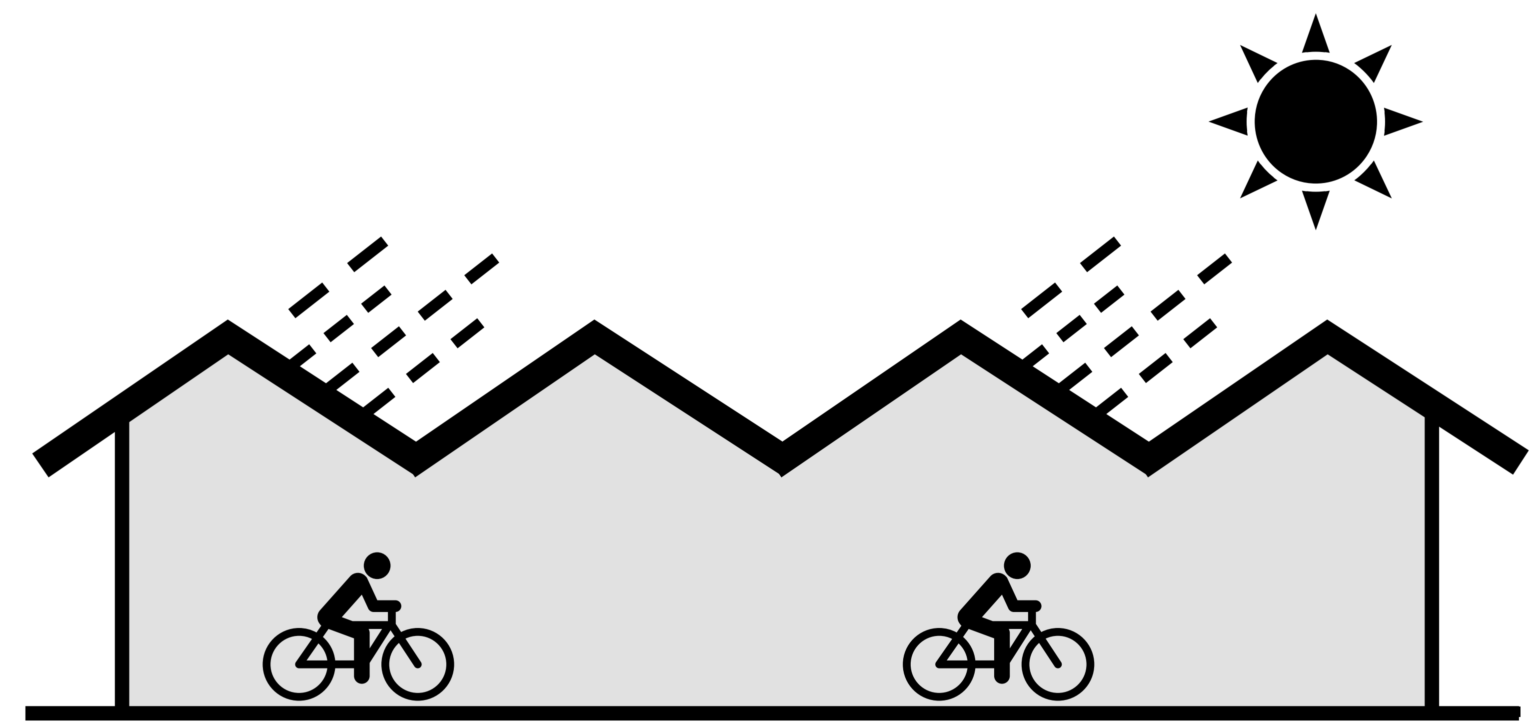


Bicycle Crossings with Road Bumps and Different Textured Materials

Continuous Bike Lane

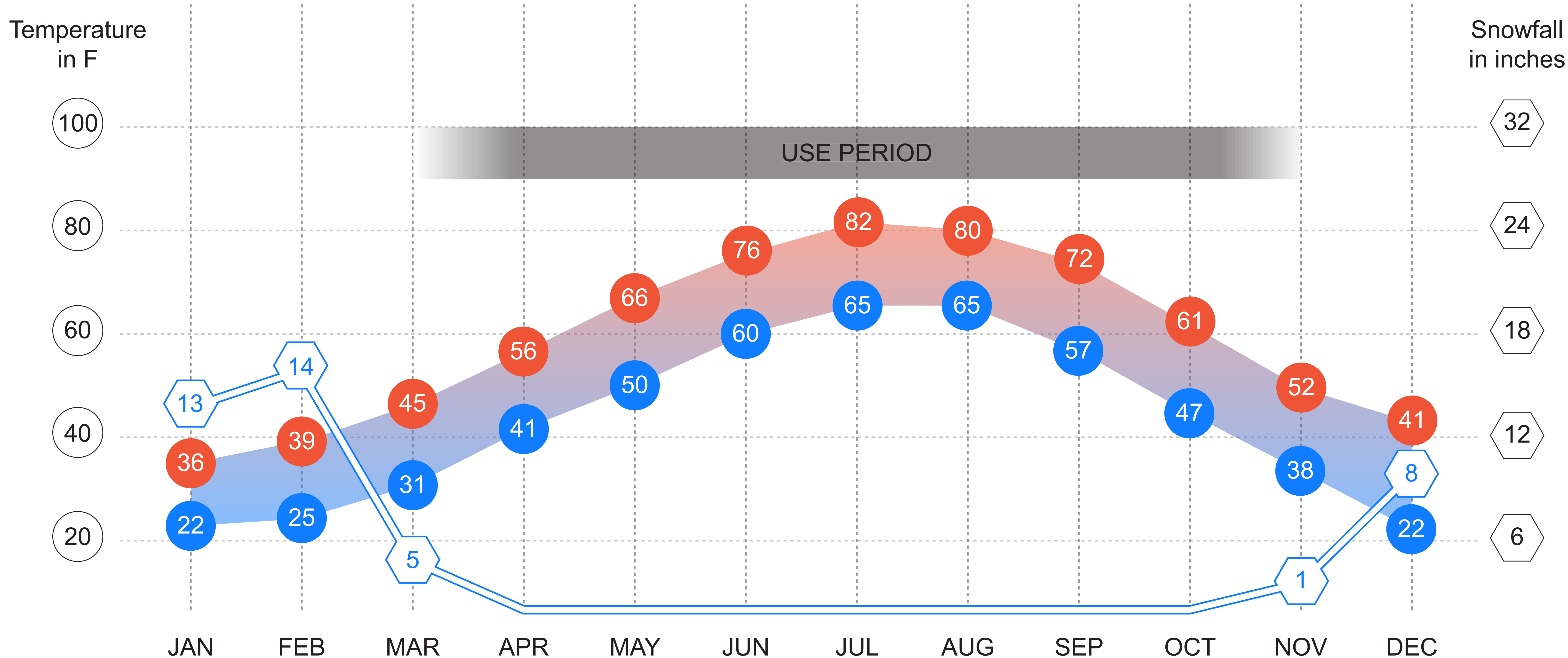
PERSONAL MOBILITY GOALS

Sufficient vegetation/landscaping for shading



Sufficient outdoor man-made structures for shading

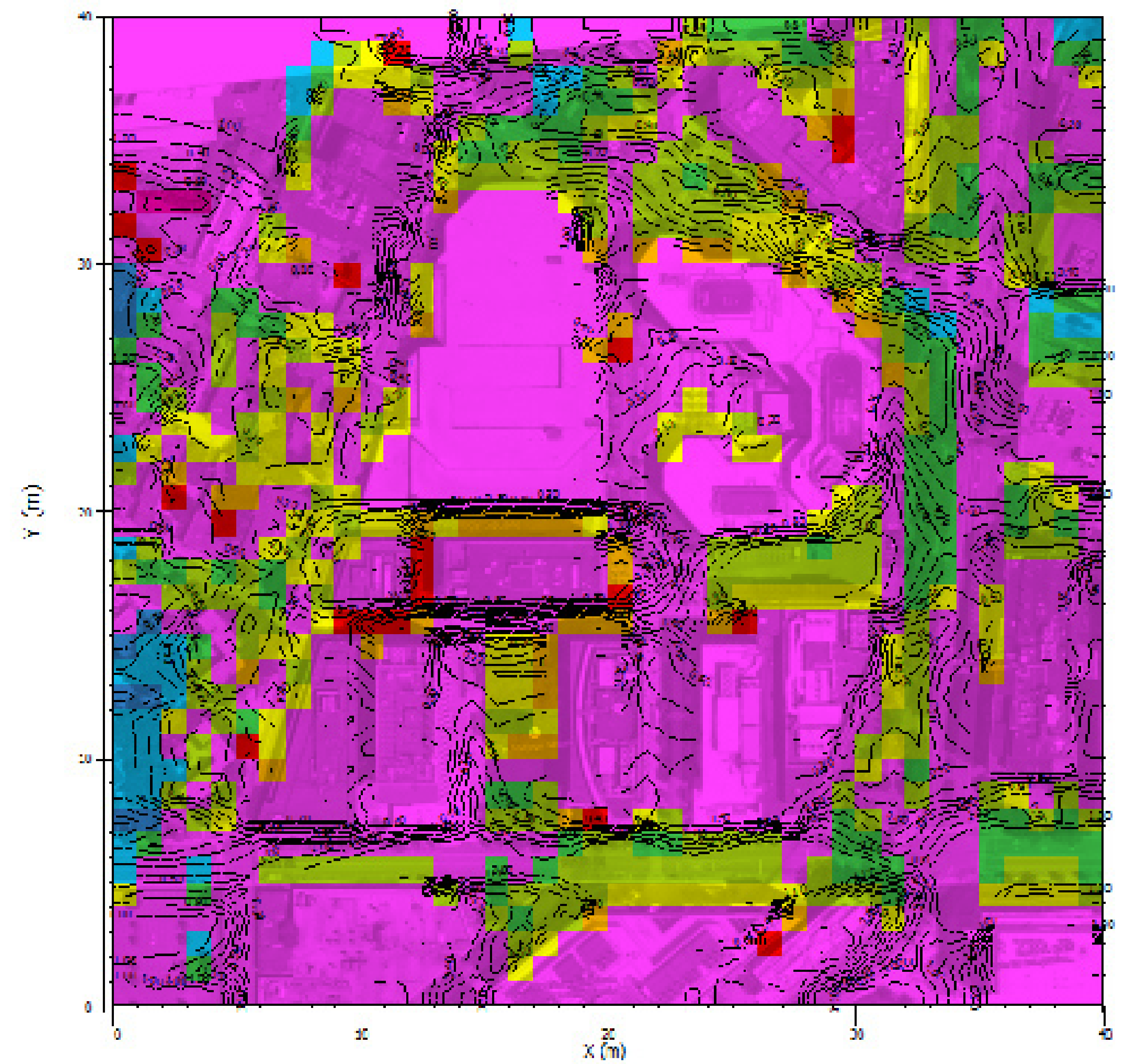
OUTDOOR COMFORT GOALS



CLIMATE IN CAMBRIDGE

temperature and snowfall

above 16.10 °C
13.85 – 16.10 °C
11.60 – 13.85 °C
9.35 – 11.60 °C
7.10 – 9.35 °C
4.85 – 7.10 °C
2.60 – 4.85 °C
-0.35 – 2.60 °C
-1.90 – -0.35 °C
below -1.90 °C

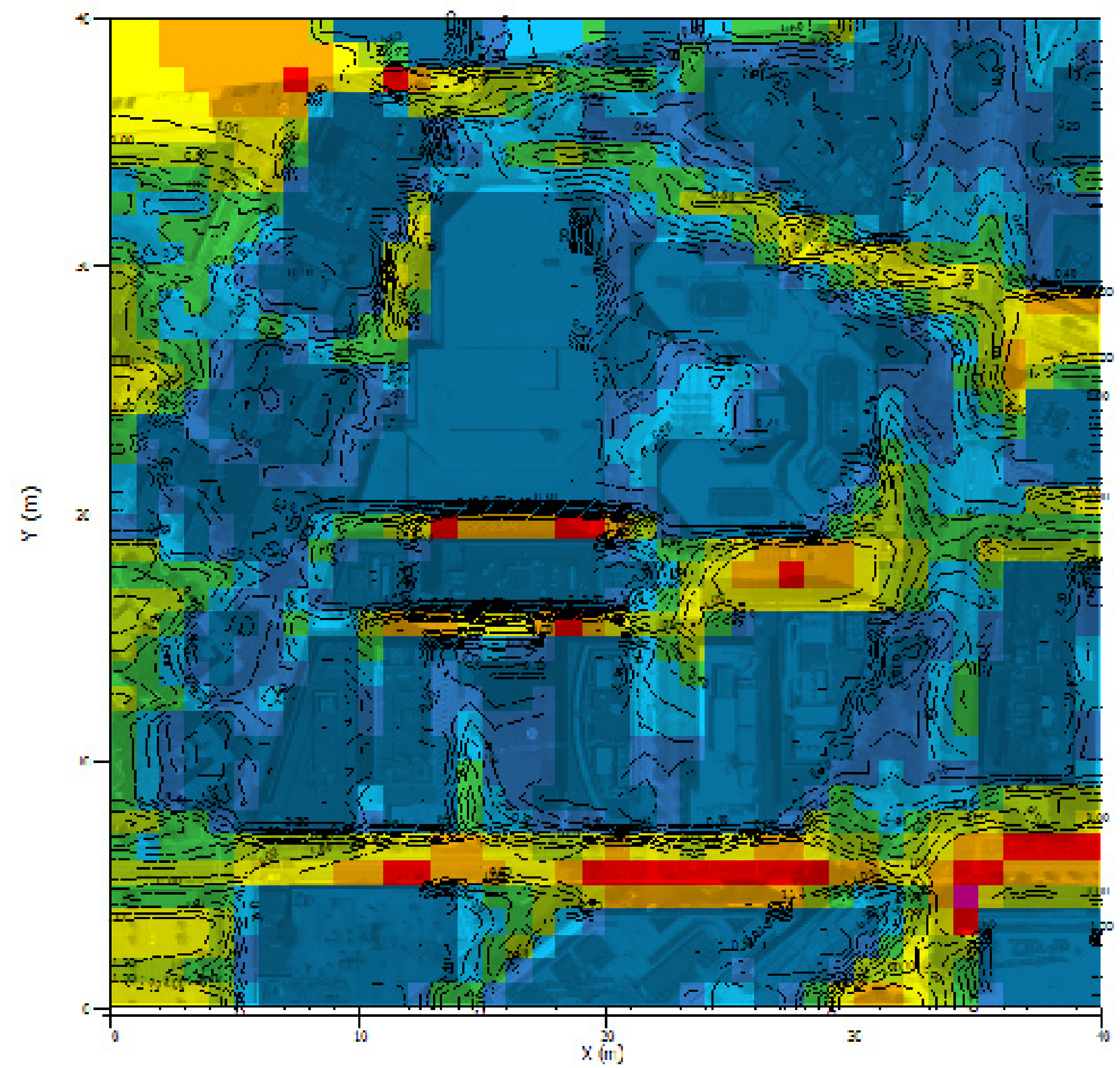


QUANTIFYING COMFORT

mean radiant temperature

degrees celsius

- above 1.8 m/s
- 1.6 – 1.8 m/s
- 1.4 – 1.6 m/s
- 1.2 – 1.4 m/s
- 1.0 – 1.2 m/s
- 0.8 – 1.0 m/s
- 0.6 – 0.8 m/s
- 0.4 – 0.6 m/s
- 0.2 – 0.4 m/s
- below 0.2 m/s

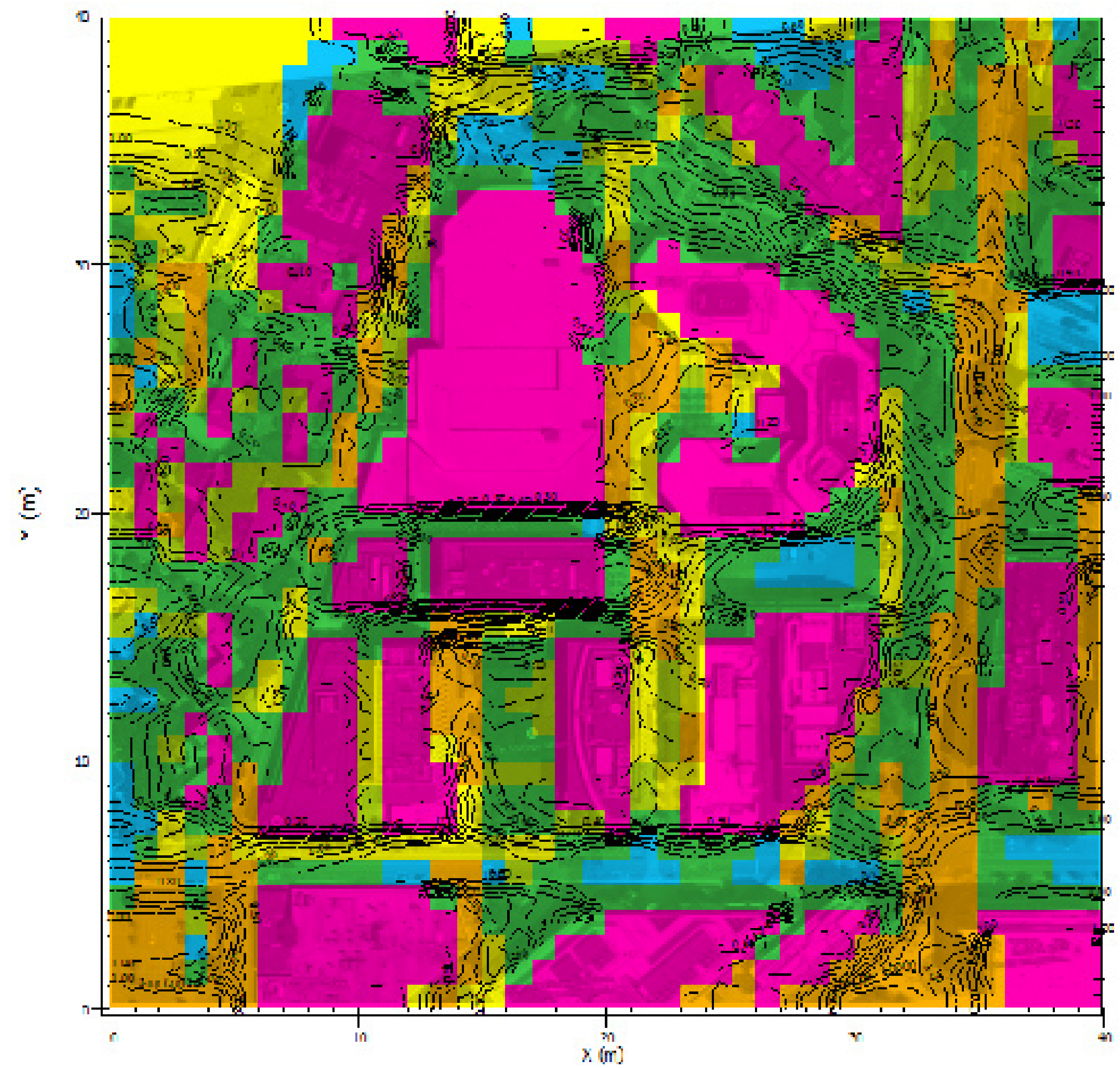


QUANTIFYING COMFORT

wind speed

meters per second

above 0.25
0.00 – 0.25
-0.25 – 0.00
-0.50 – -0.25
-0.75 – -0.50
-1.00 – -0.75
-1.25 – -1.00
-1.50 – -1.25
-1.75 – -1.50
below -1.75



QUANTIFYING COMFORT

predicted mean vote

Technology Square

MOBILITY REDESIGN AND DEVELOPMENT

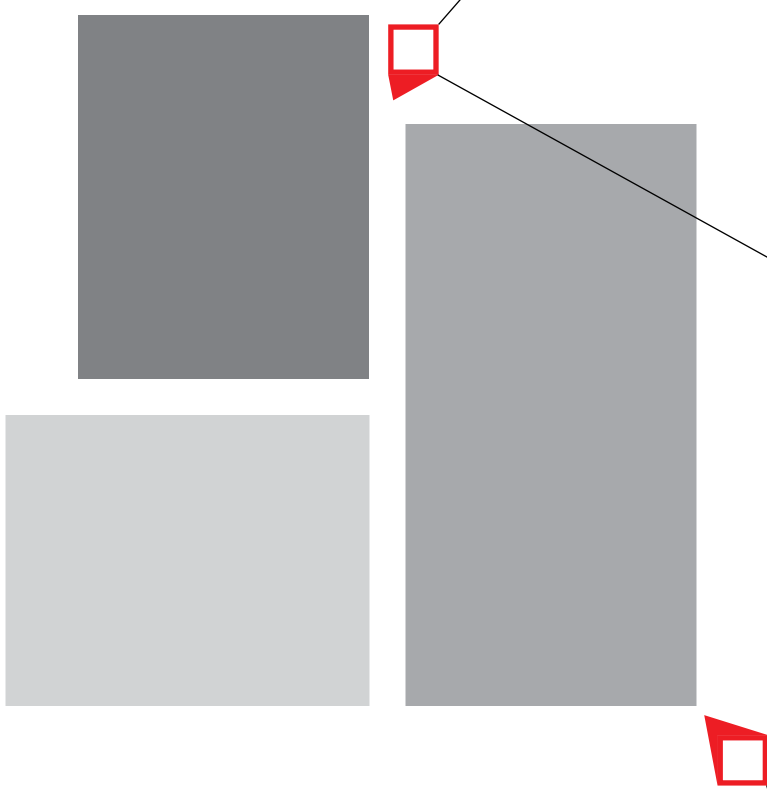
01

NATHANIEL JONES [MIT PHD BT], ALI IRANI [MIT UG ARCH+CIVIL]


HARVARD
SOMERVILLE
BROADWAY ST
HARVARD ST
PROSPECT ST
MASS AVE
CAMBRIDGEPORT
MIT

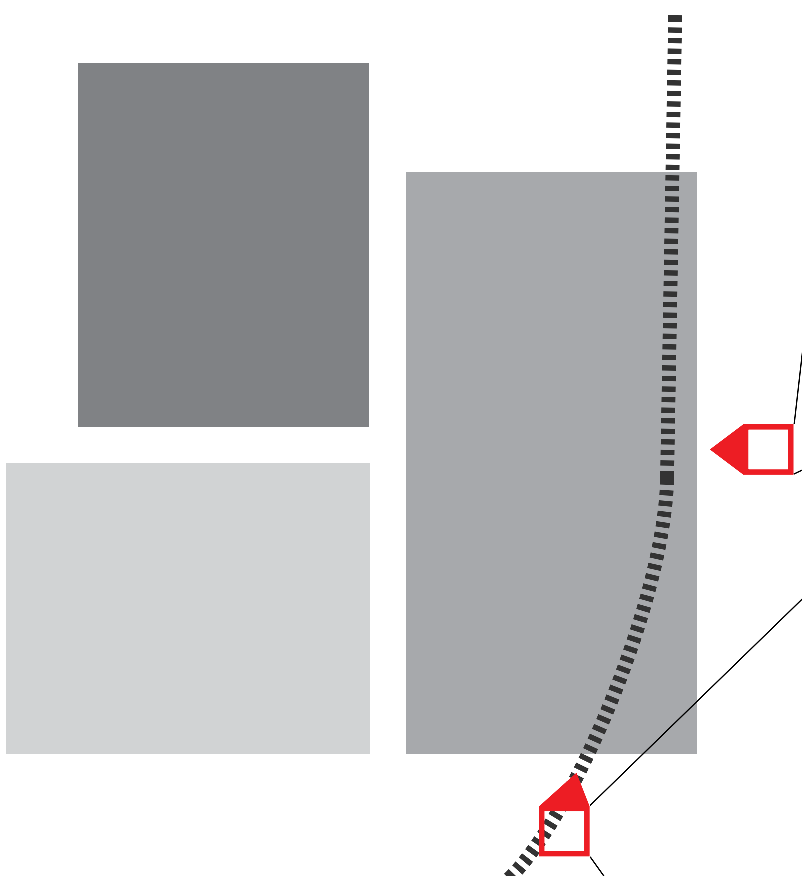
TABLE OF CONTENTS

SITE PROBLEMS



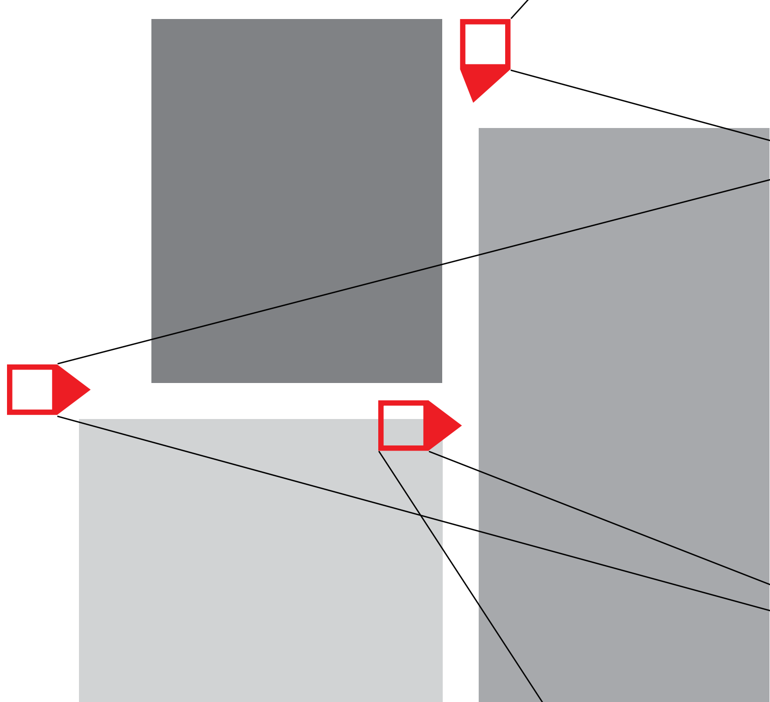
SITE PROBLEMS

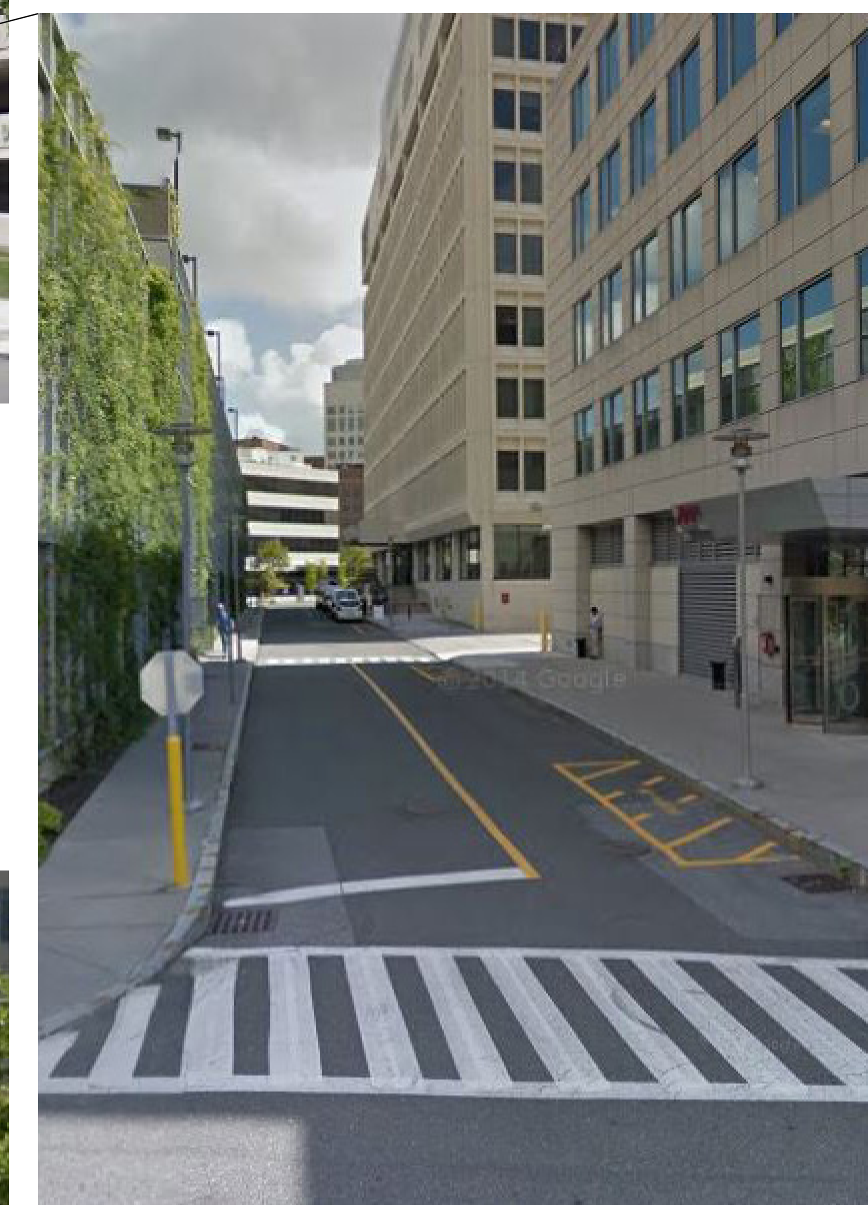
big intersections

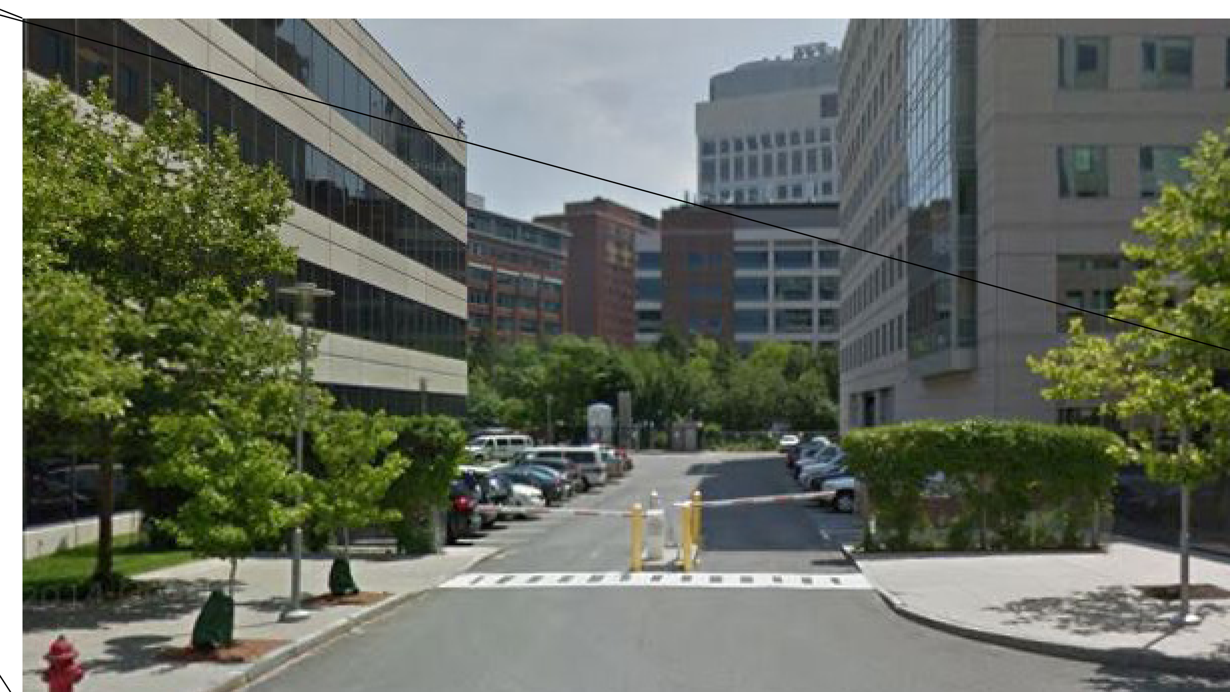


SITE PROBLEMS

poor east-west connectivity







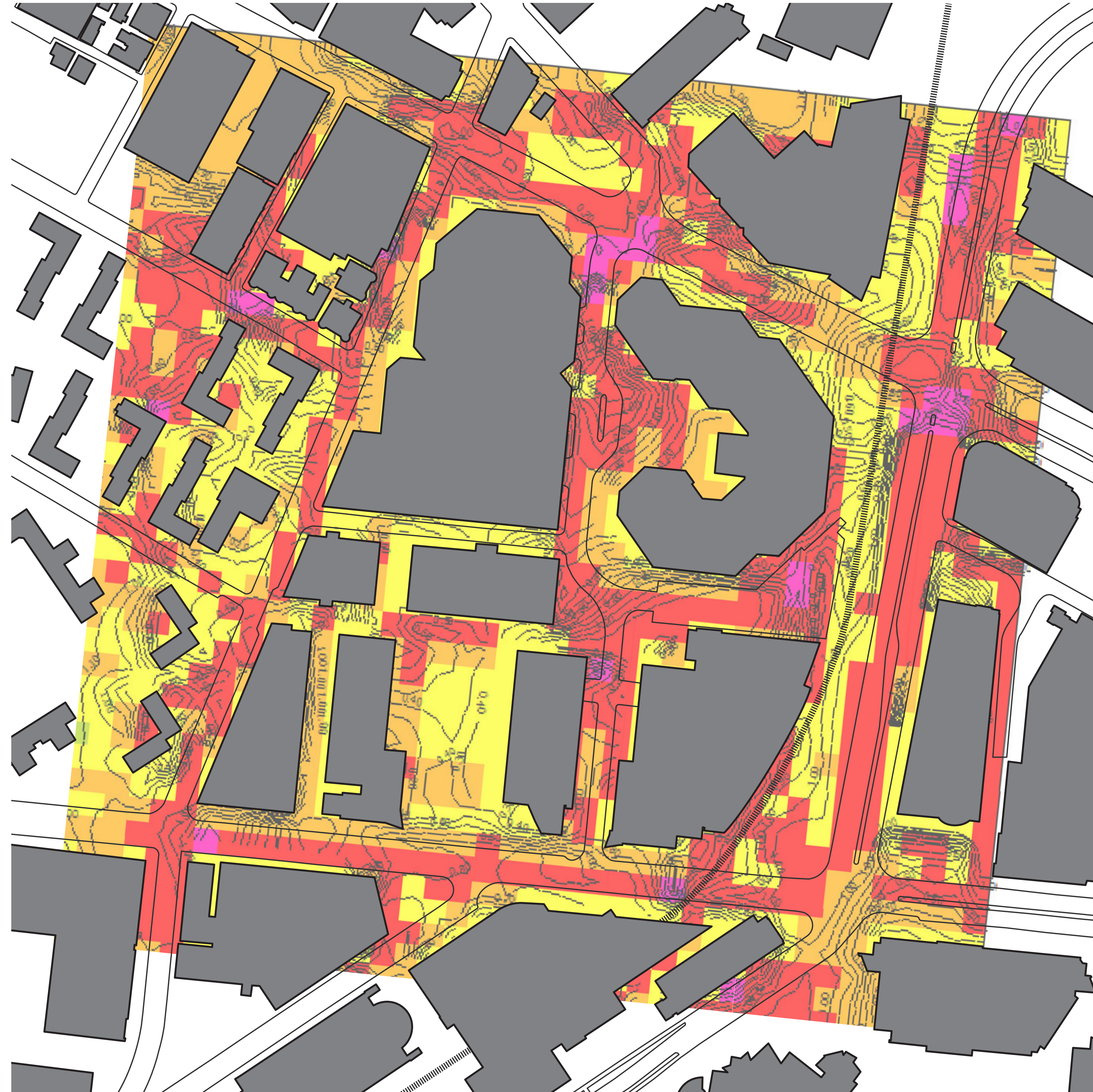
SITE PROBLEMS

unfriendly built environment

Predicted Mean Vote

May 16, Noon

above 3.00
2.25 – 3.00
1.50 – 2.25
0.75 – 1.50
Comfort Band 0.00 – 0.75
-0.75 – 0.00
-1.50 – -0.75
-2.25 – -1.50
-3.00 – -2.25
below -3.00



SITE PROBLEMS

thermal comfort, analysis (spring)

Predicted Mean Vote

November 15, Noon

	above 3.00
	2.25 – 3.00
	1.50 – 2.25
	0.75 – 1.50
Comfort Band	0.00 – 0.75
	-0.75 – 0.00
	-1.50 – -0.75
	-2.25 – -1.50
	-3.00 – -2.25
	below -3.00

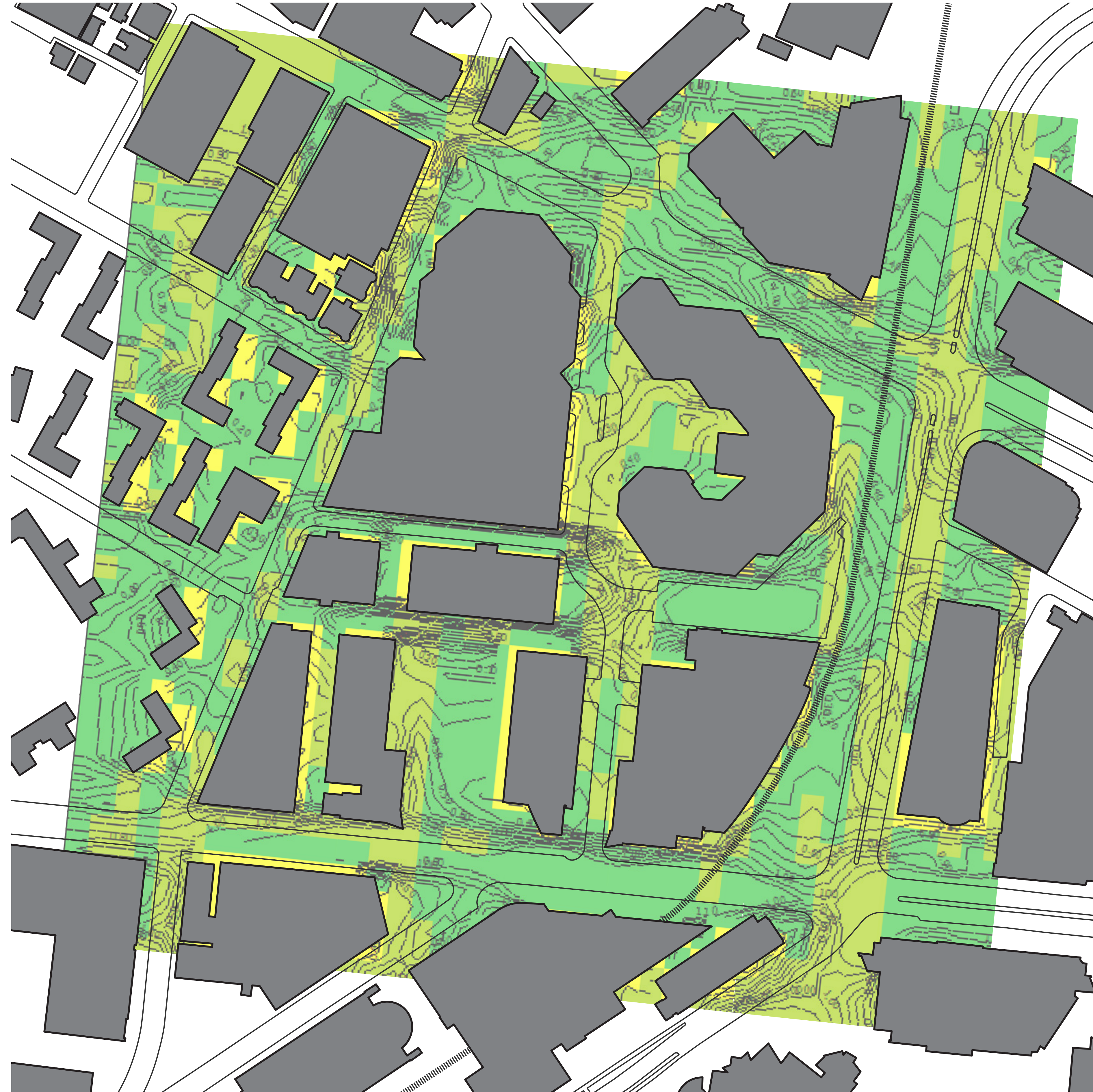
SITE PROBLEMS

thermal comfort, analysis (fall)

Predicted Mean Vote

January 23, Noon

	above 3.00
	2.25 – 3.00
	1.50 – 2.25
	0.75 – 1.50
Comfort Band	0.00 – 0.75
	-0.75 – 0.00
	-1.50 – -0.75
	-2.25 – -1.50
	-3.00 – -2.25
	below -3.00



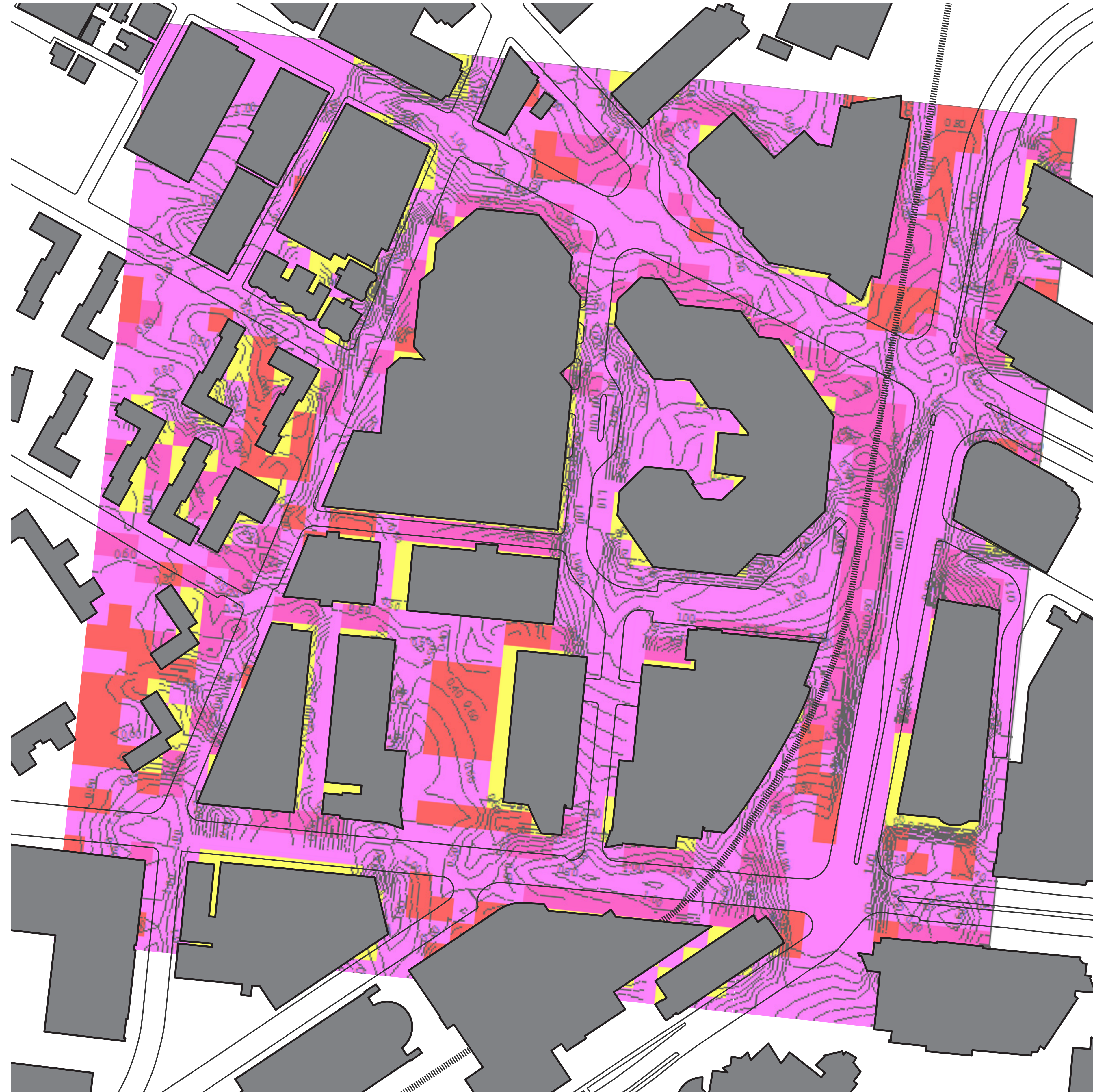
SITE PROBLEMS

thermal comfort, analysis (winter)

Predicted Mean Vote

July 19, Noon

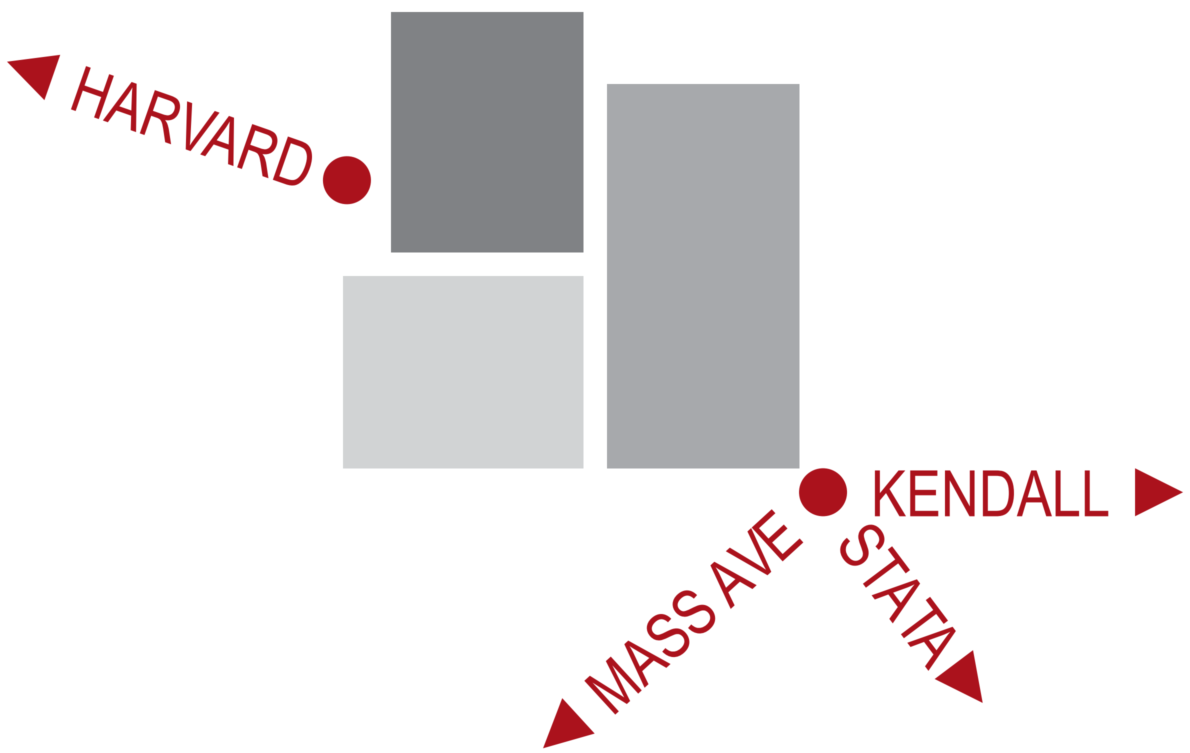
	above 3.00
	2.25 – 3.00
	1.50 – 2.25
	0.75 – 1.50
Comfort Band	0.00 – 0.75
	-0.75 – 0.00
	-1.50 – -0.75
	-2.25 – -1.50
	-3.00 – -2.25
	below -3.00

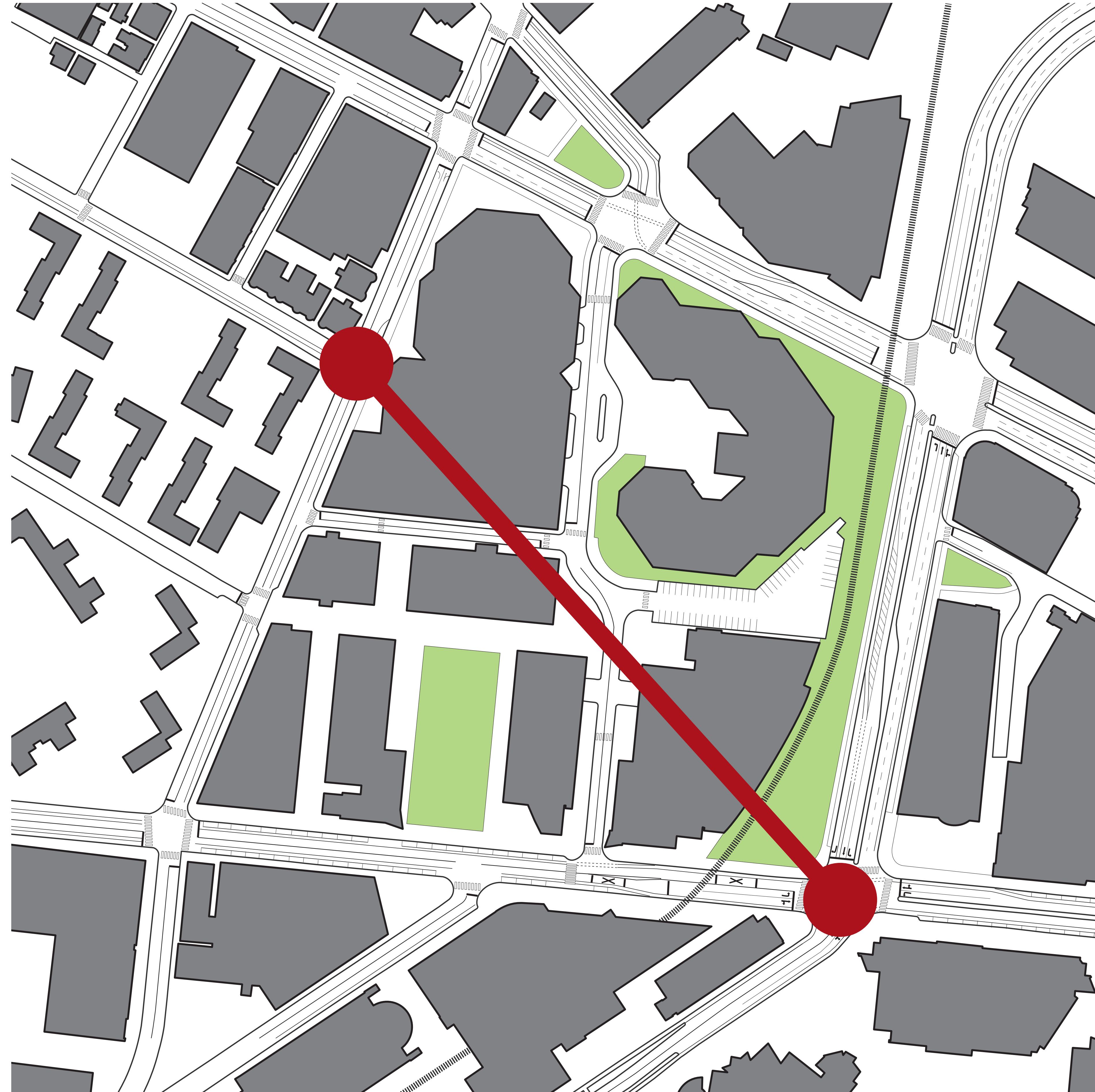


SITE PROBLEMS

thermal comfort, analysis (summer)

SITE STRATEGIES

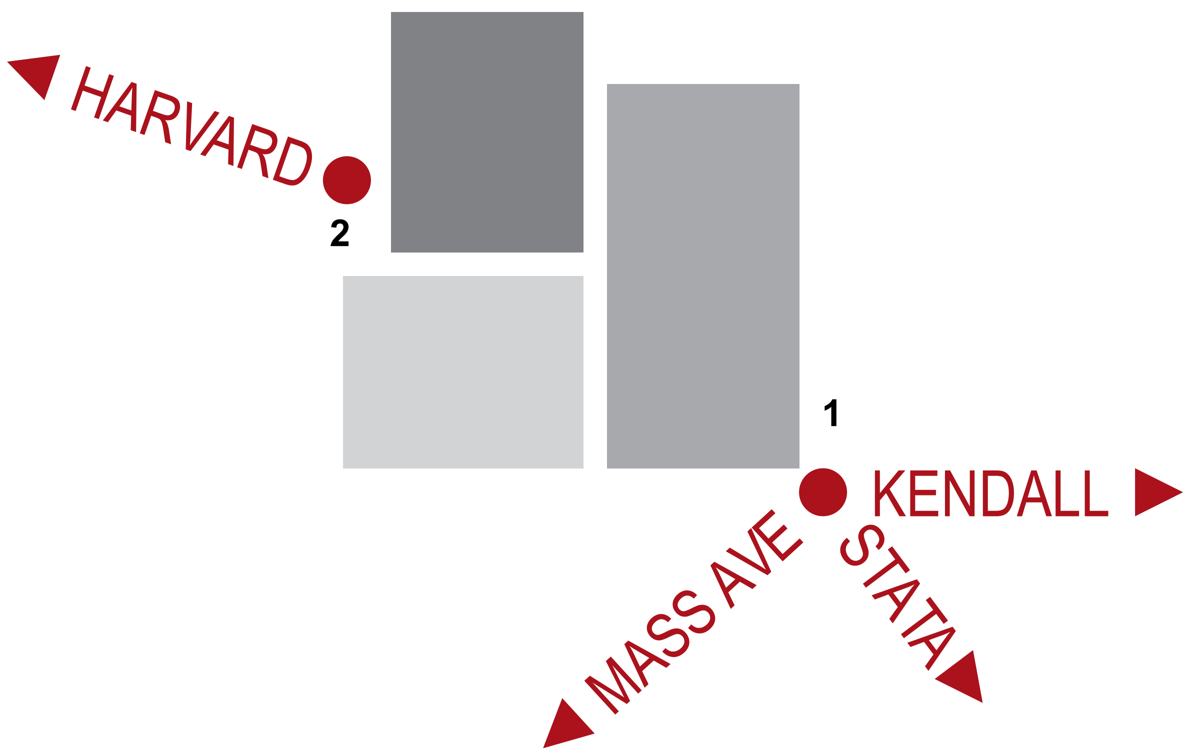


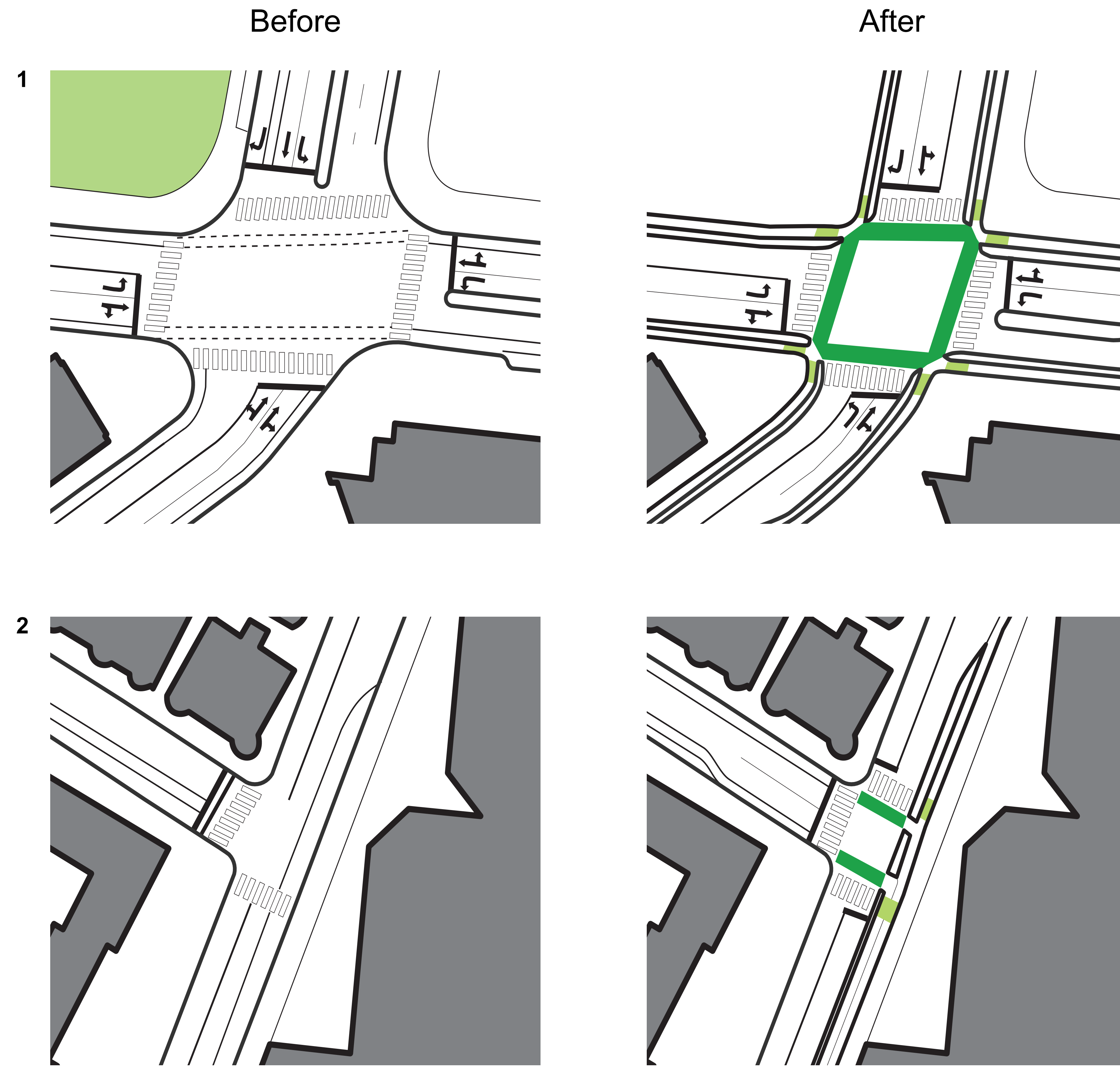


SITE STRATEGIES

gateway to MIT and Kendall Square

Intersection Design





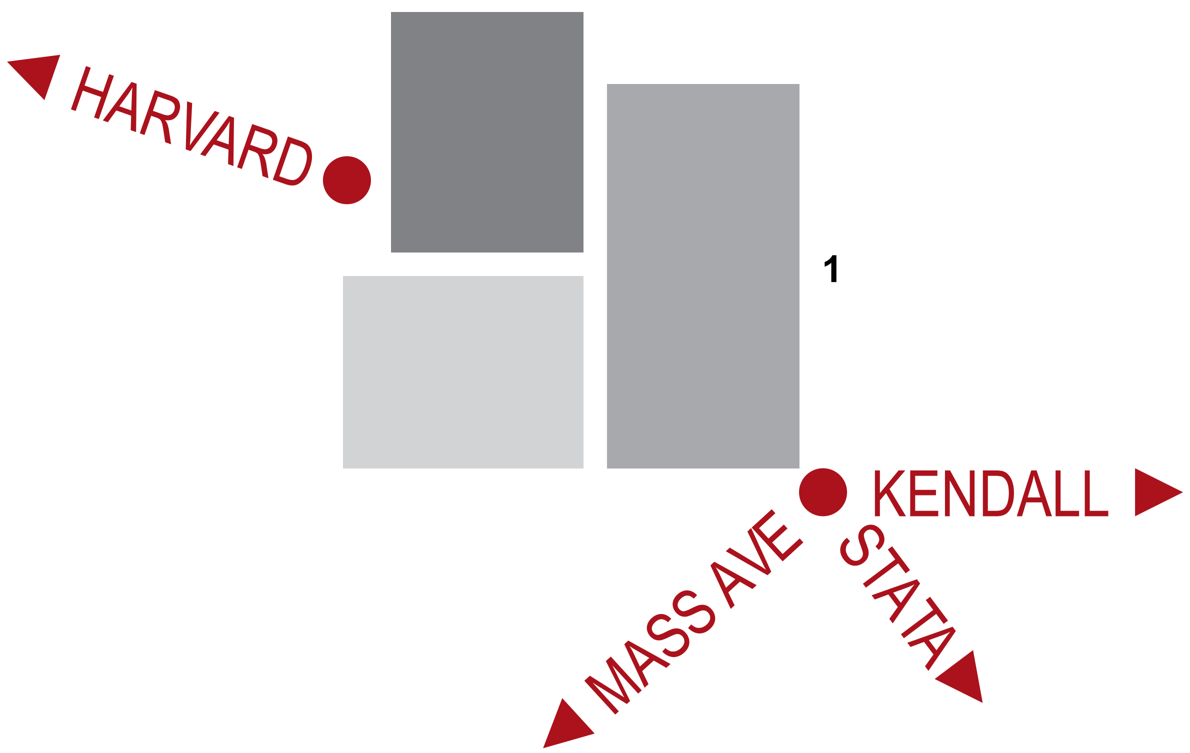
POLICY MEAURES

- Reduce intersection widths
- Marked bicycle crossings

SITE STRATEGIES

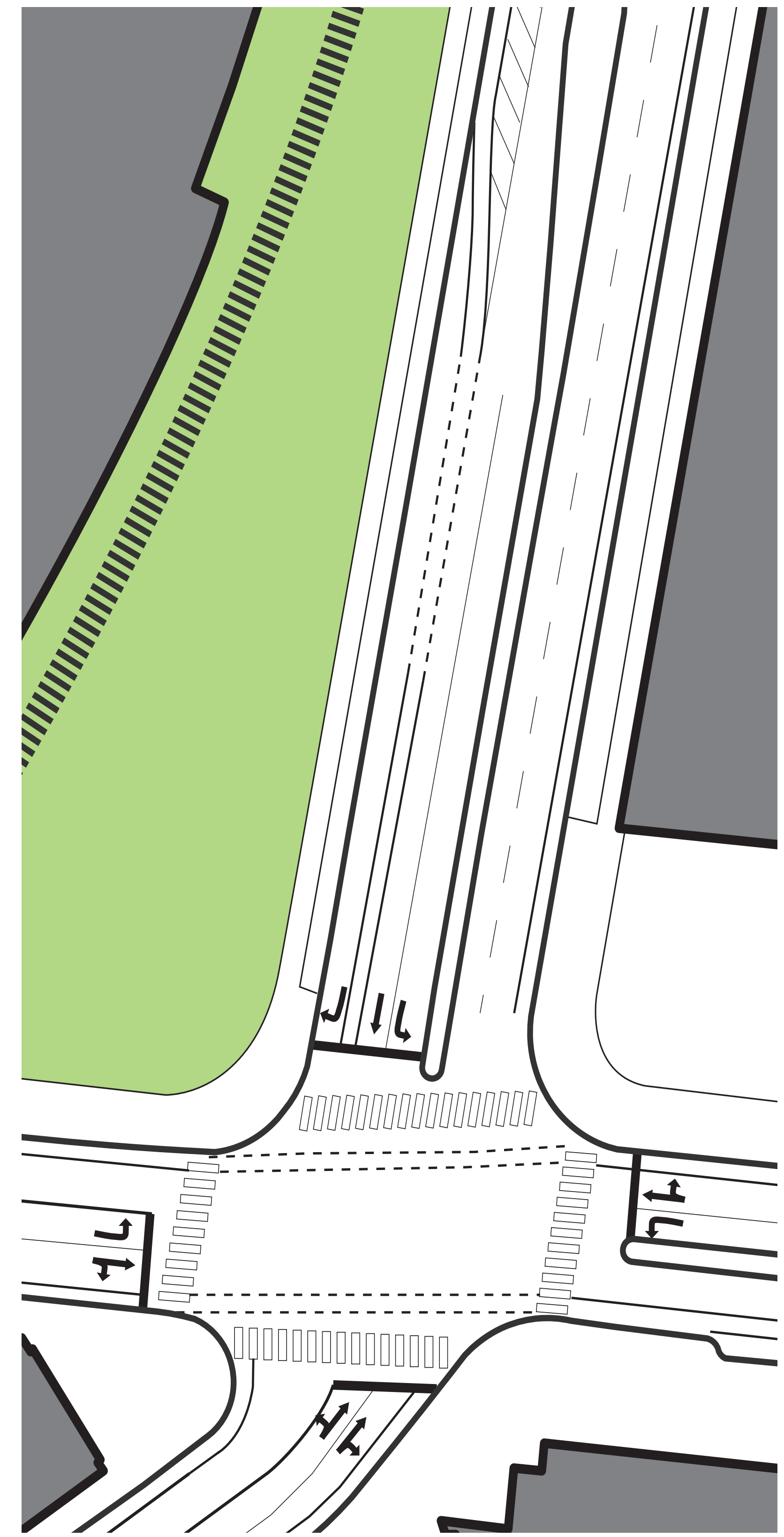
gateway to MIT and Kendall Square

Street Design

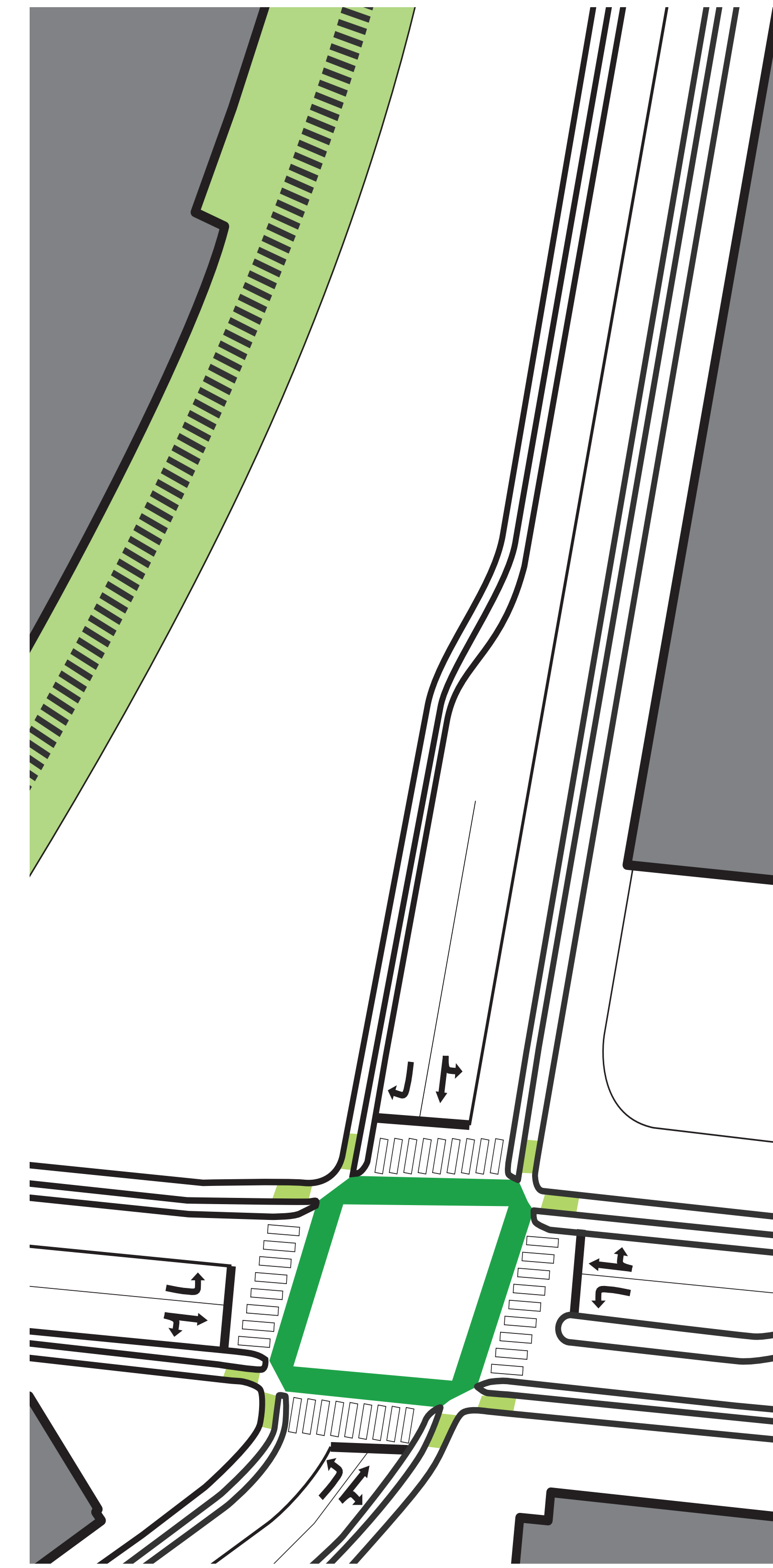


Before

1



After

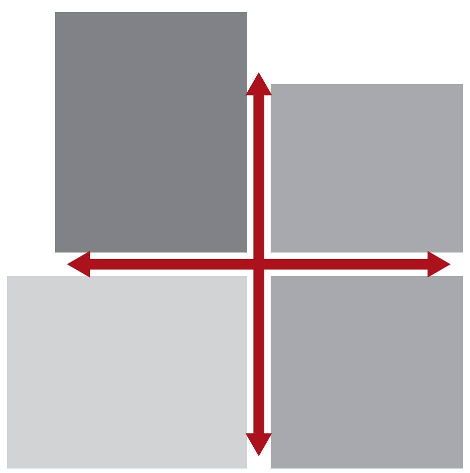


POLICY MEAURES

- Lane and road diets
- Lower speed limits

SITE STRATEGIES

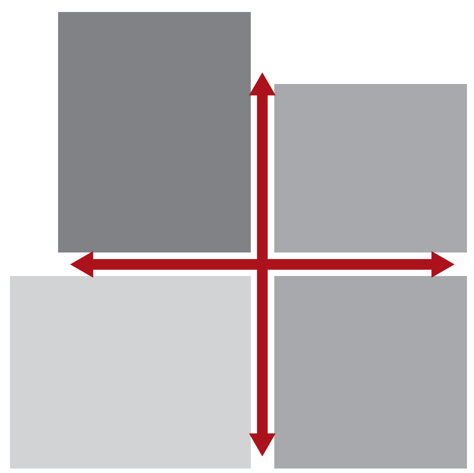
gateway to MIT and Kendall Square



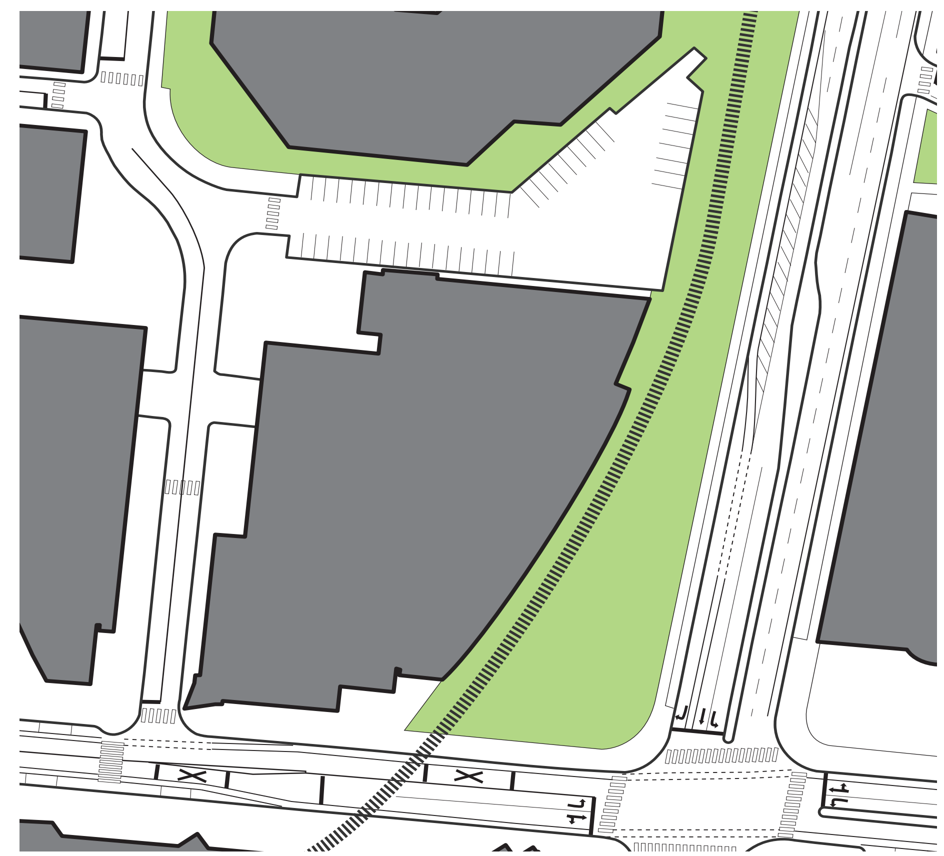
SITE STRATEGIES

connectivity established and developed

Bicycle Infrastructure



Before



After

POLICY MEAURES

- Reduced vehicular access
- Bicycle tracks
- Additional railroad crossing

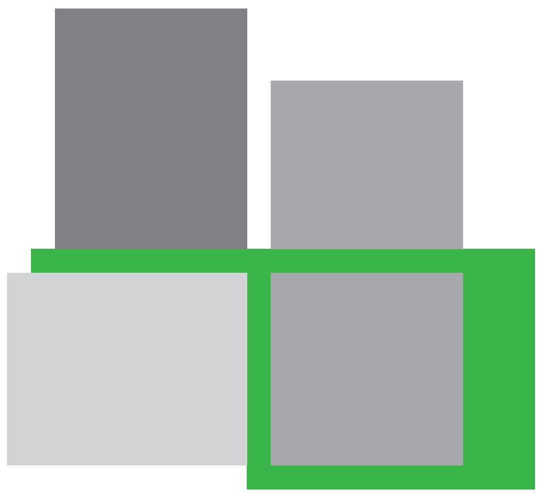
SITE STRATEGIES

connectivity established and developed

SITE STRATEGIES

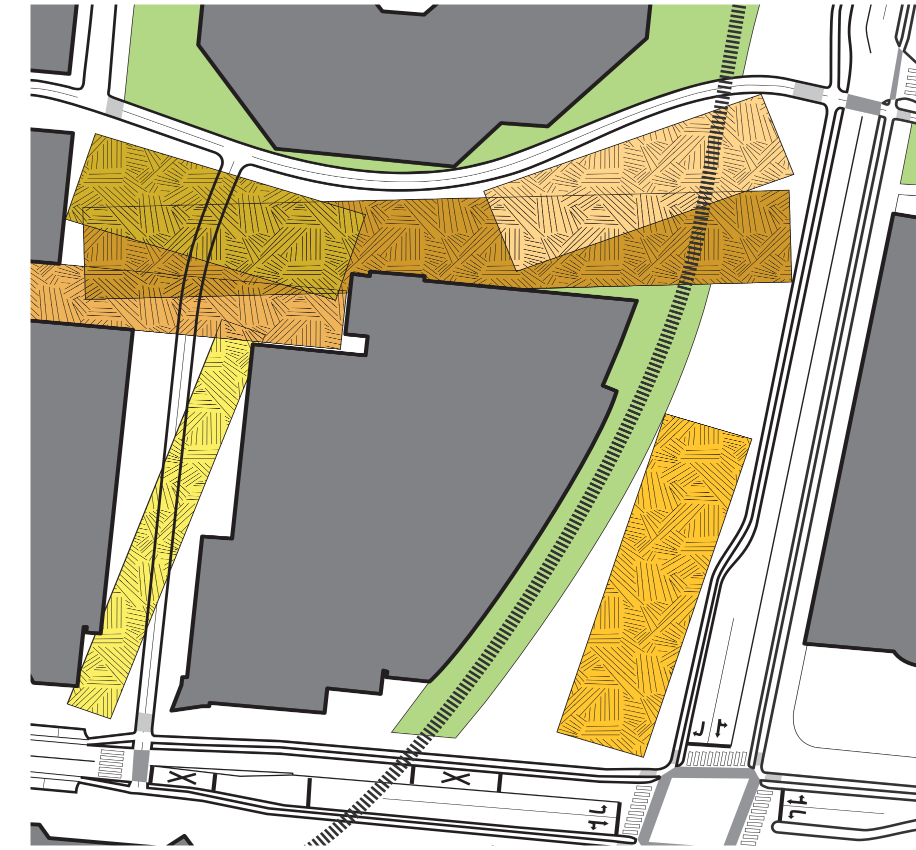
public space reclaimed and developed

Public Space: Surfaces



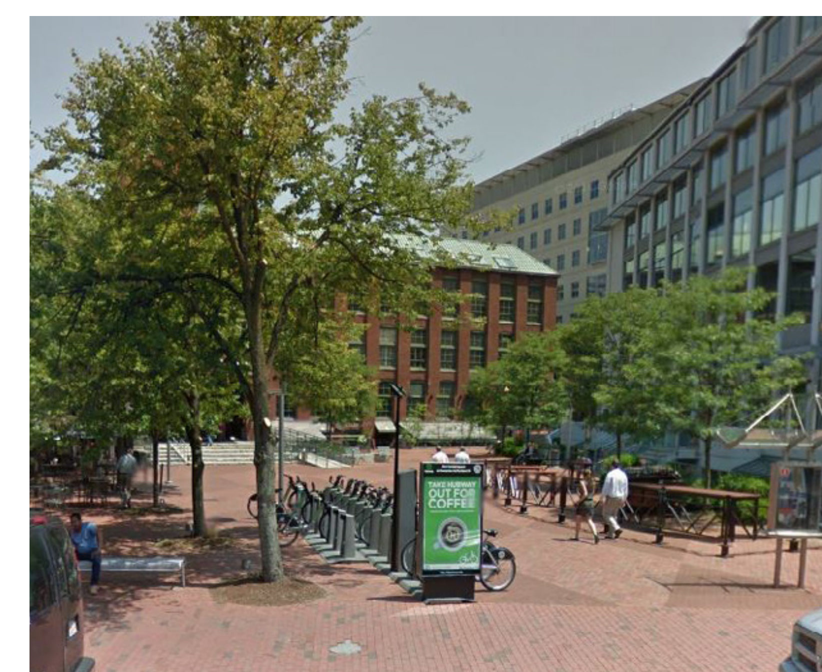
Before

After



POLICY MEAURES

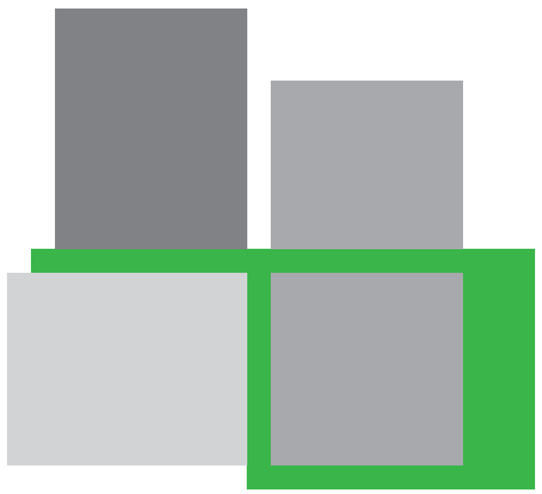
- Open public spaces and wide sidewalks
- Street furniture
- Host public events and cultural attractions
- Space for food vendors

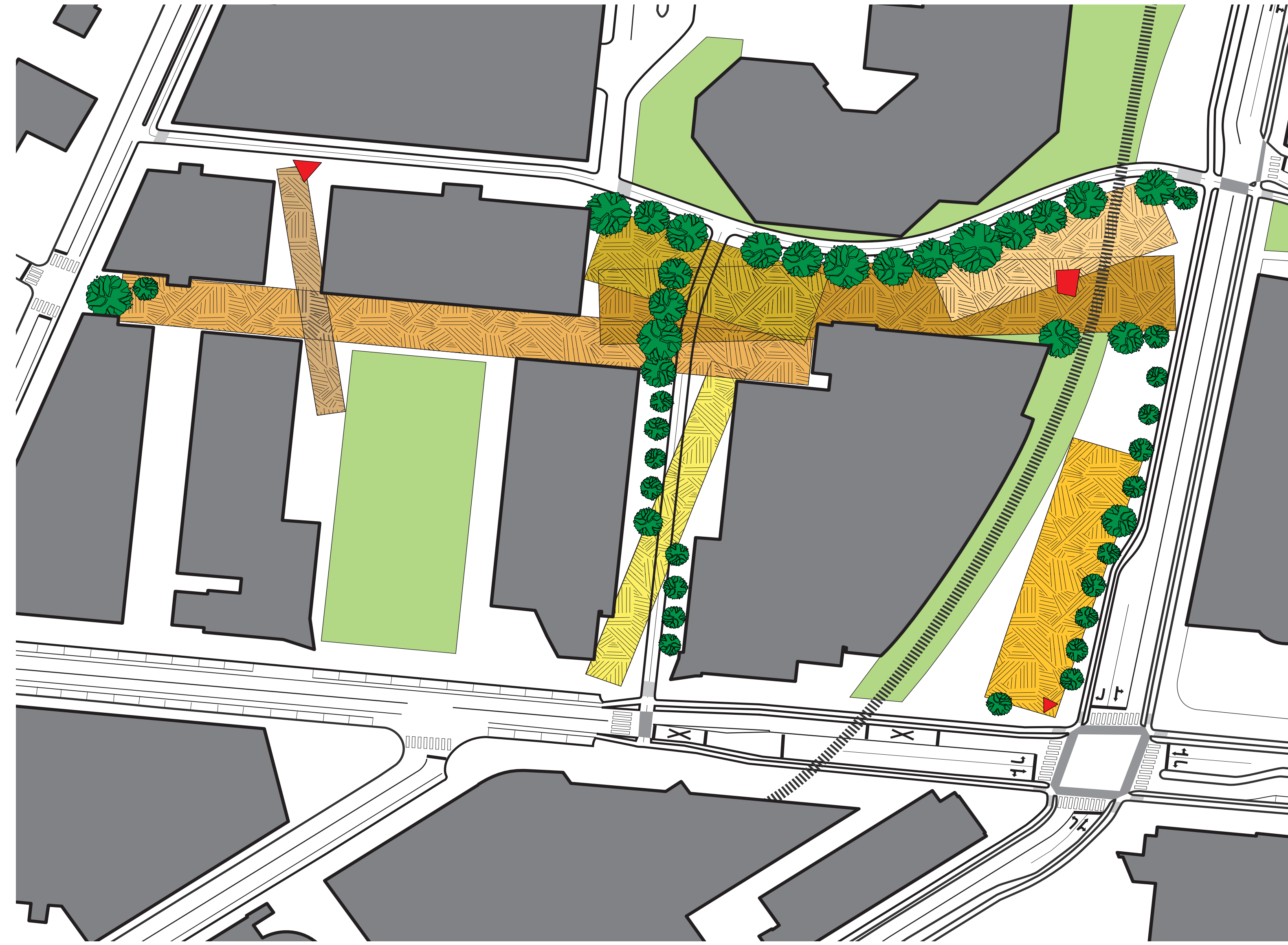


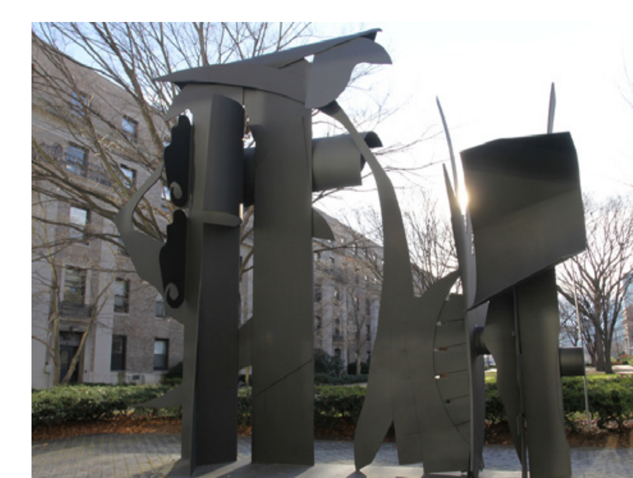
SITE STRATEGIES

public space reclaimed and developed

Public Space: Trees and Art





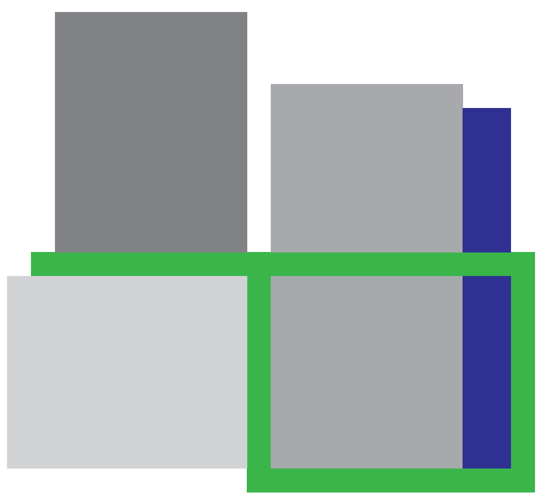


POLICY MEAURES

- Provide shading and wind buffers
- Plant variety of trees
- Sculptures and art by local artists

SITE STRATEGIES

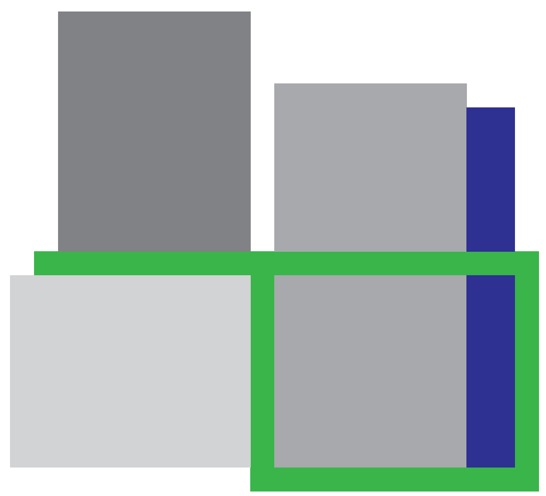
public space reclaimed and developed



SITE STRATEGIES

retail areas expanded and added

Addition of Retail Zones



POLICY MEAURES

- Zoning for mixed-use retail and residential
- Management and maintenance policies

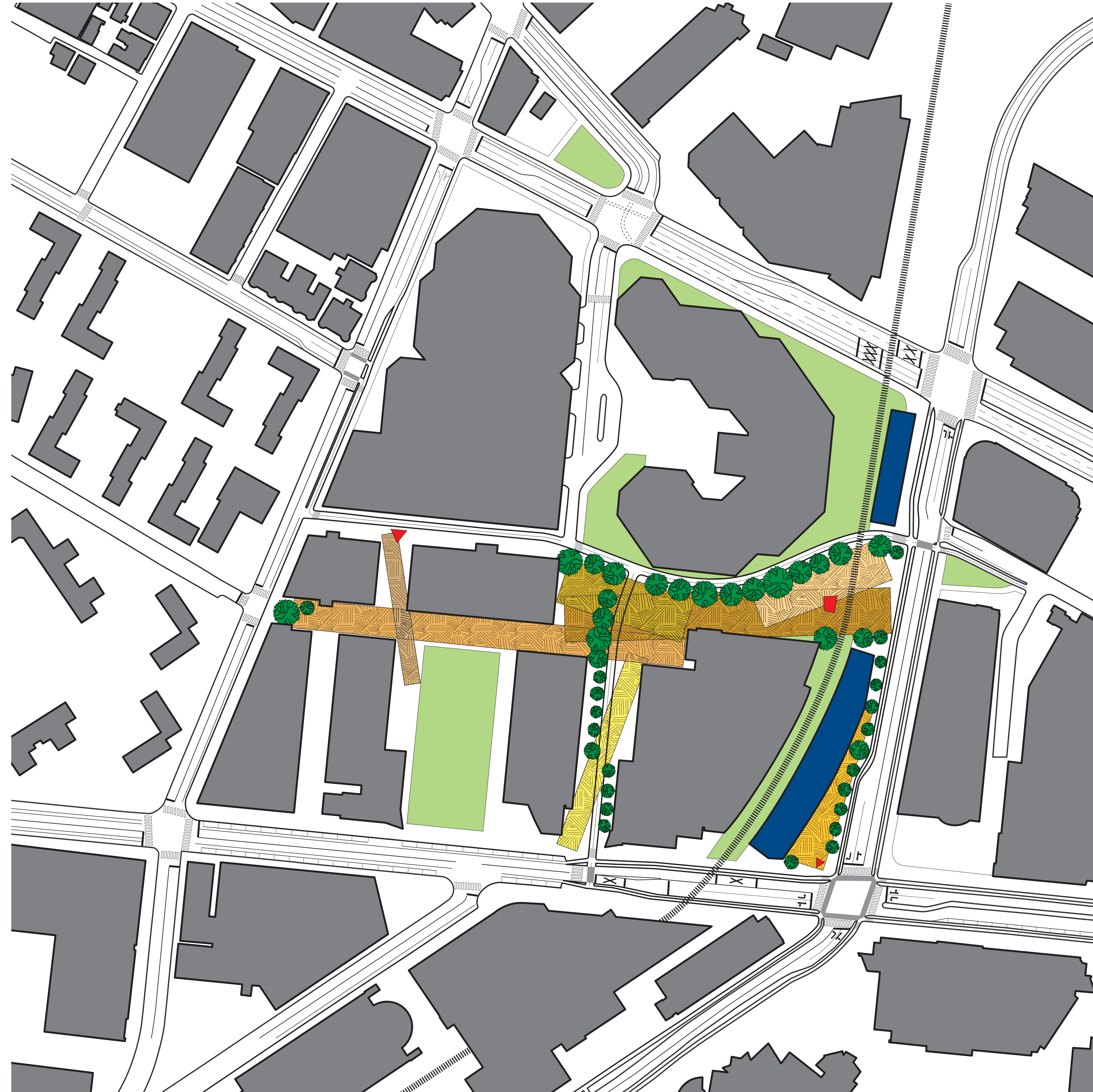
SITE STRATEGIES

retail areas expanded and added

Before

After

FINAL VISION



02

Prospect[s] Enhanced

Designing for Bikeability, Comfort and Liveability

MARIANA BALLINA [MIT UG BT], KRISTINA ELDRENKAMP [MIT M_ARCH], MANOS SARATSIS [MIT SMARCHS URBANISM]


SOMERVILLE
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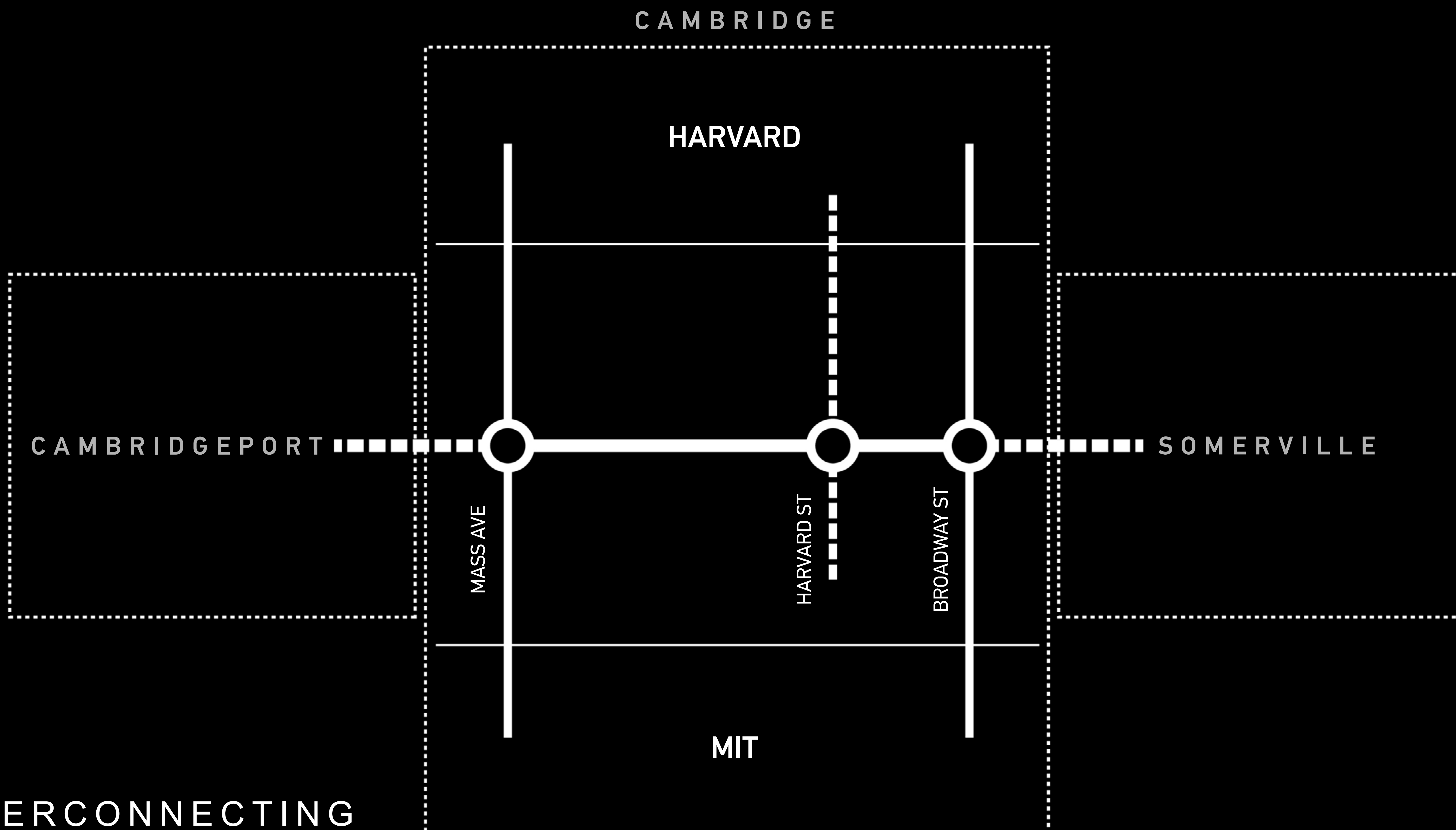
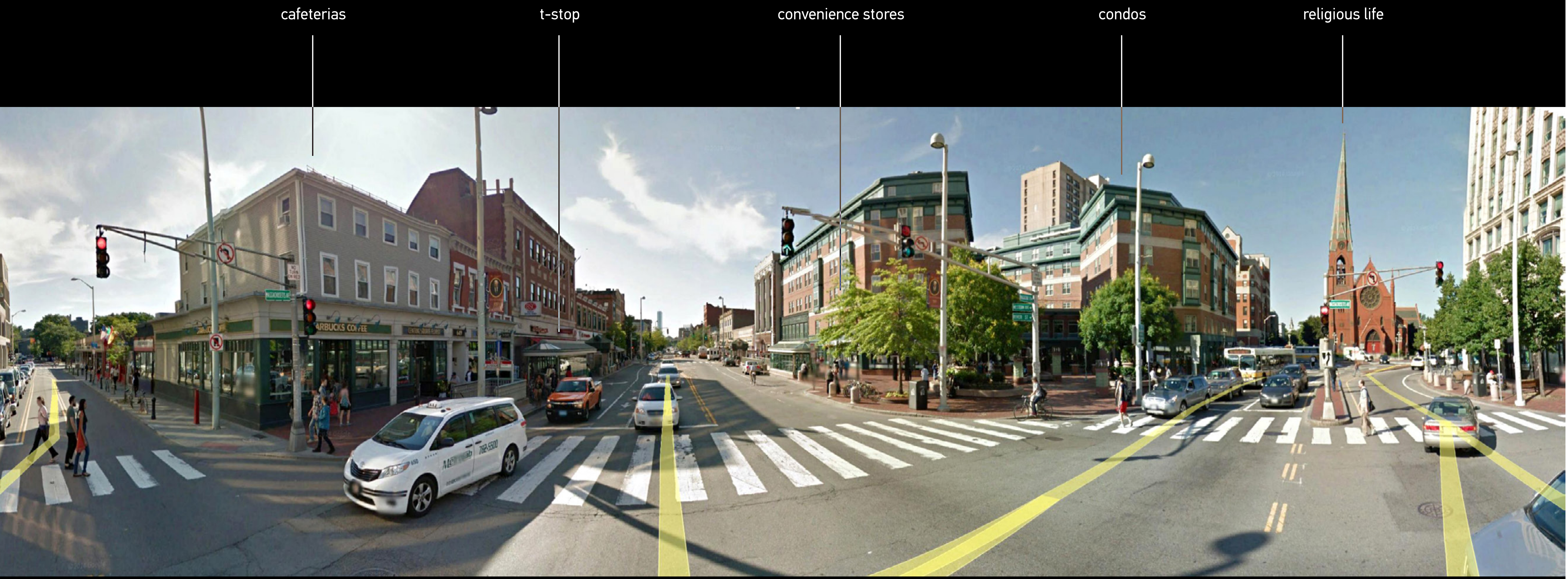


INTERCONNECTING
ARTERIAL



ADJACENT TO CIVIC CENTER

HISTORICALLY
LIVELY & COMMERCIAL

HISTORICALLY
LIVELY & COMMERCIAL

HISTORICALLY
LIVELY & COMMERCIAL

CURRENT CONDITIONS

WHAT TO MAINTAIN

Positive qualities of the street

well-located
convenient to transit and stores
good mix of uses
residential scale
active at all hours

WHAT TO IMPROVE

Pedestrian environment

uncomfortable
narrow sidewalks
lack of pedestrian-oriented lighting
large curbs
trucks on sidewalk

Street image and character

lack of coherence
lack of greenery
parking lots on sidewalk
noise from traffic and trucks

Traffic flow and safety

high volumes
high speeds
difficult for bicycles
limited pedestrian crossings

CITIZEN FEEDBACK

Source: City of Cambridge, Community Development Dept.
Public Meetings, February-June 2006

01

MAINTAIN VIBRANCE

encourage active
ground floor uses
require glazed facades
and openness

02

MAINTAIN MIXED-USE

introduce the Prospect
street overlay district
designate as 'corridor of
special planning concern'

03

IMPROVE STREET

tree planting
street furniture
repaving
reduce curb cuts
reduce parking

04

IMPROVE IMAGE

shield incompatible
uses visually
and acoustically
create buffers
improve signage

05

ENCOURAGE TREES

minimum front yard
requirement
one tree for every 25'
on city sidewalk
15% open space
for commercial uses

CITY'S RESPONSE

Source: City of Cambridge, Community Development Dept.
Public Meetings, February-June 2006

VIBRANT

improve community life through developing an active corridor

01 02

MULTIMODAL

promote multimodal transit and enhance commuting options

02

BIKEABLE

improve bikeability with well-planned, higher quality infrastructure

03 04

COMFORTABLE

improve outdoor comfort conditions through materials and foliage

04 05

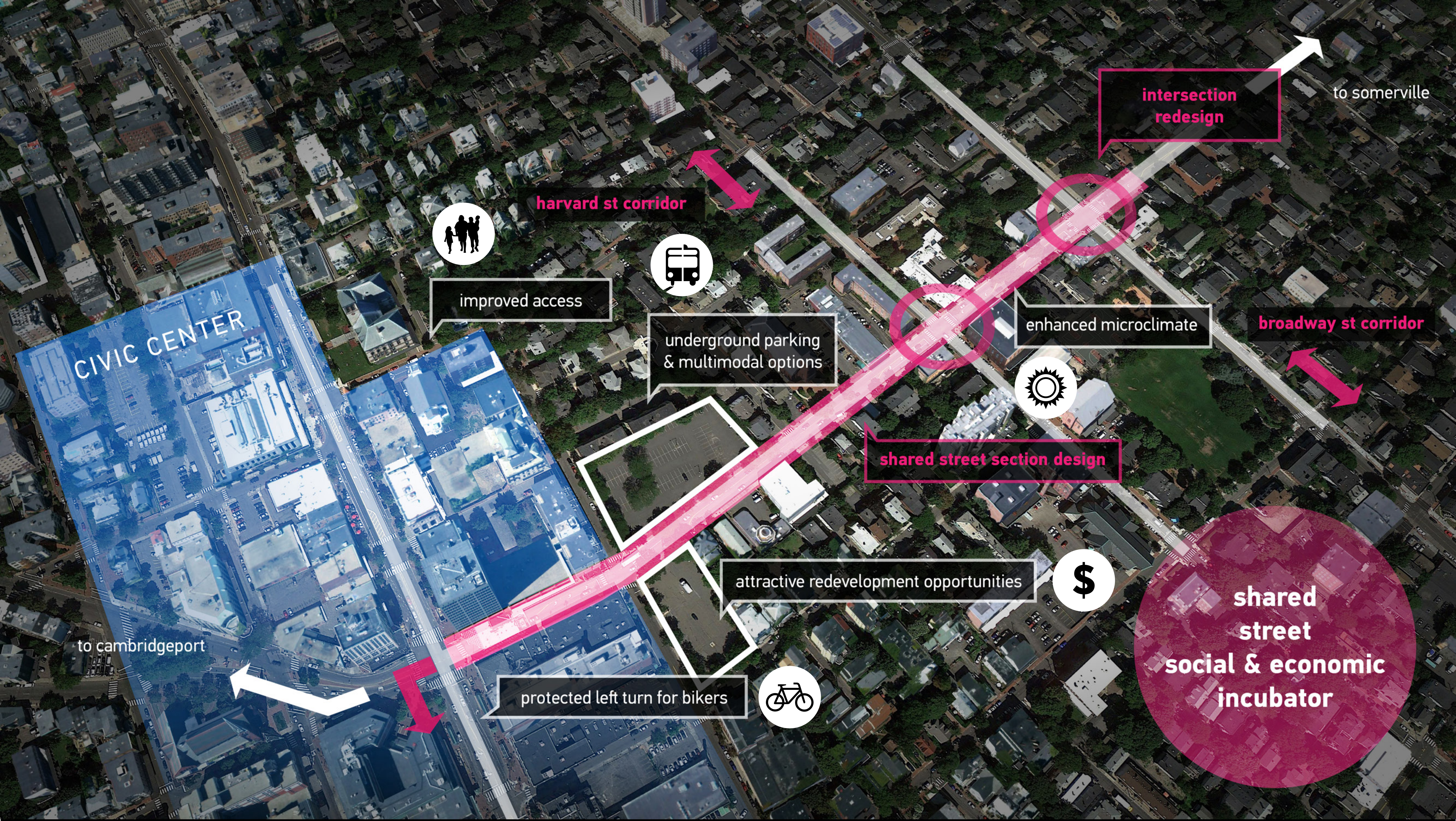
ATTRACTIVE

increase real estate potential while maintaining liveability

02 04

OUR VISION

incorporating citizen feedback and aligning with the city's plan

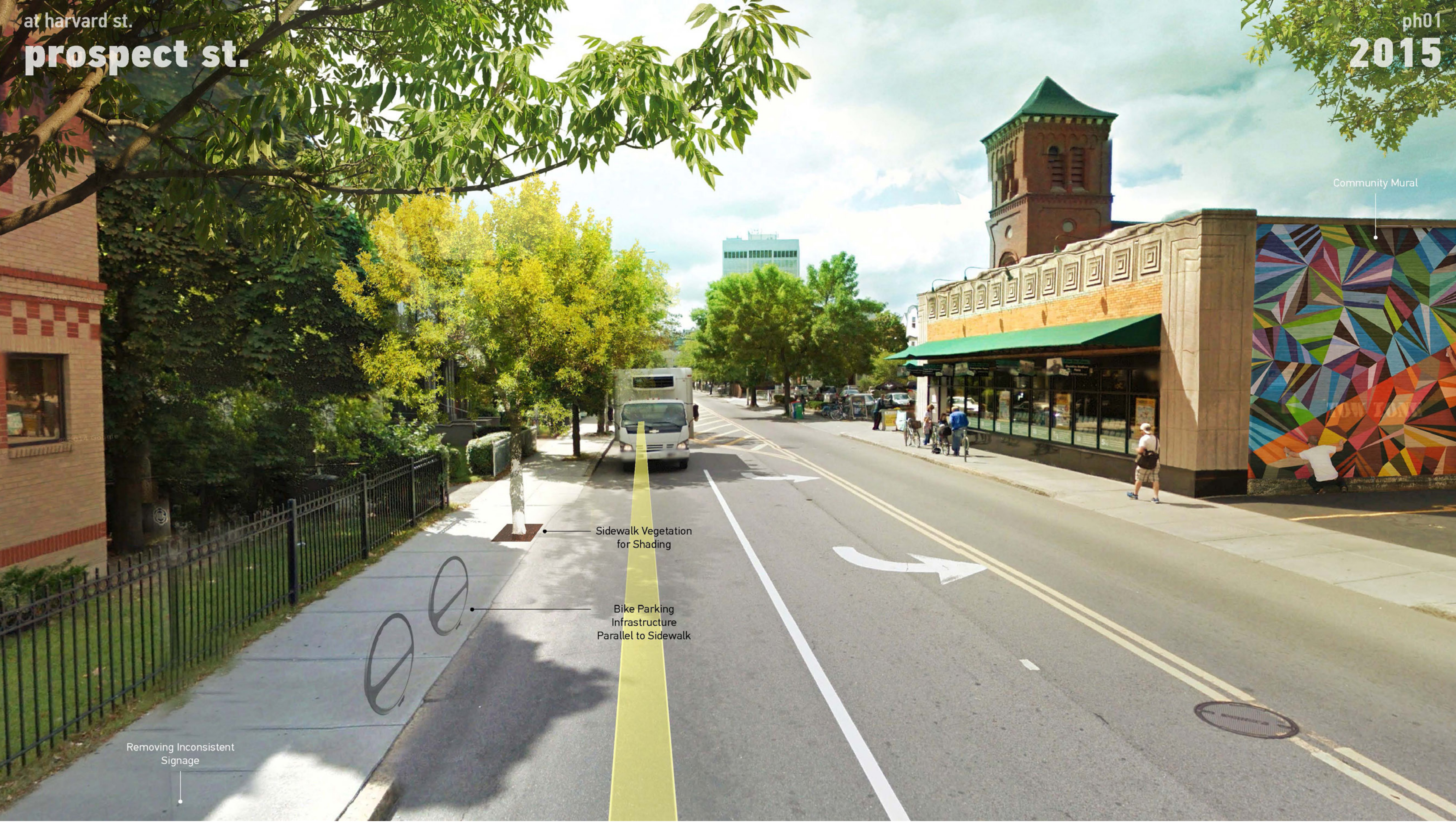


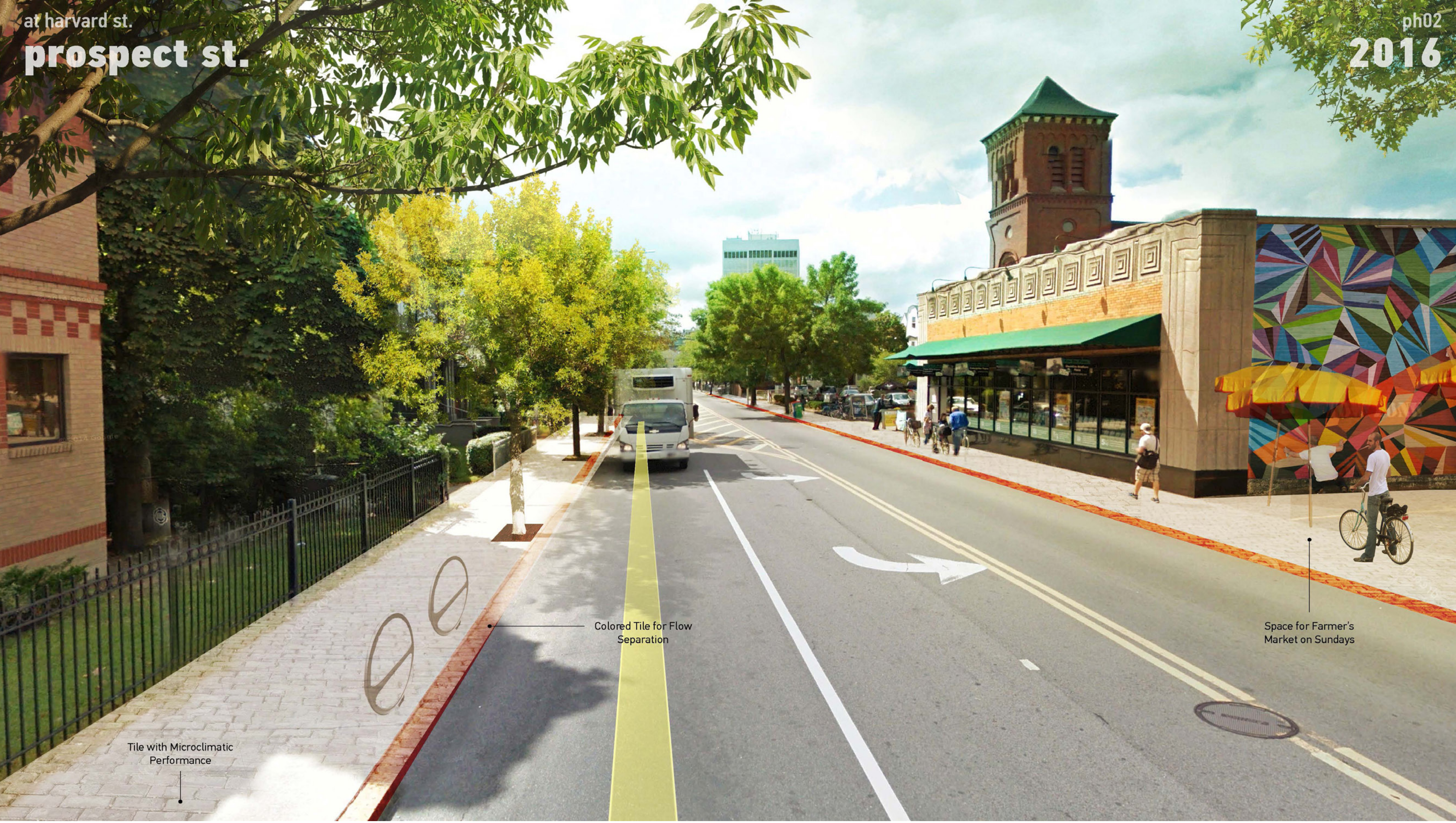
OUR VISION IN SPACE

PROSPECT SECTION

conversion to shared space for bikes, buses, automobiles

at harvard st.
prospect st.
today
2014
Signage Inconsistently Placed
Underutilized Partition Walls
TOW ZONE
Parking Fronts Street
Lack of Vegetation
Lack of Bike Parking Infrastructure
No Parking Exit Signage
Limited Sidewalk Width
No Method of Slowing Cars Down
Pothole in the Middle of Street


at harvard st.
prospect st.
ph01
2015
Community Mural
Sidewalk Vegetation for Shading
Bike Parking Infrastructure Parallel to Sidewalk
Removing Inconsistent Signage


at harvard st.
prospect st.
ph02
2016
Colored Tile for Flow Separation
Space for Farmer's Market on Sundays
Tile with Microclimatic Performance

at harvard st.

prospect st.

ph03

2016

EXISTING CONDITIONS

MEDIUM TO HIGH VOLUME
14,000 vehicles per day (580 vehicles/hour)

HIGH CRASH RATE
84 crashes on Broadway at Prospect

TRUCK EXCLUSION
entire length

SIGNAL COORDINATION
favors southbound traffic

CITY'S TARGET
improve safety for all modes
without increasing congestion

IMPROVEMENT POINTS

01 **REDUCING VEHICLE SPEED AT 15 mph**
employing speed bumps and street surface material

02 **REDUCING INTERSECTION CRASHES**
designing raised intersections

03 **MAINTAINING TRAVEL EFFICIENCY**
removing 90-second traffic lights

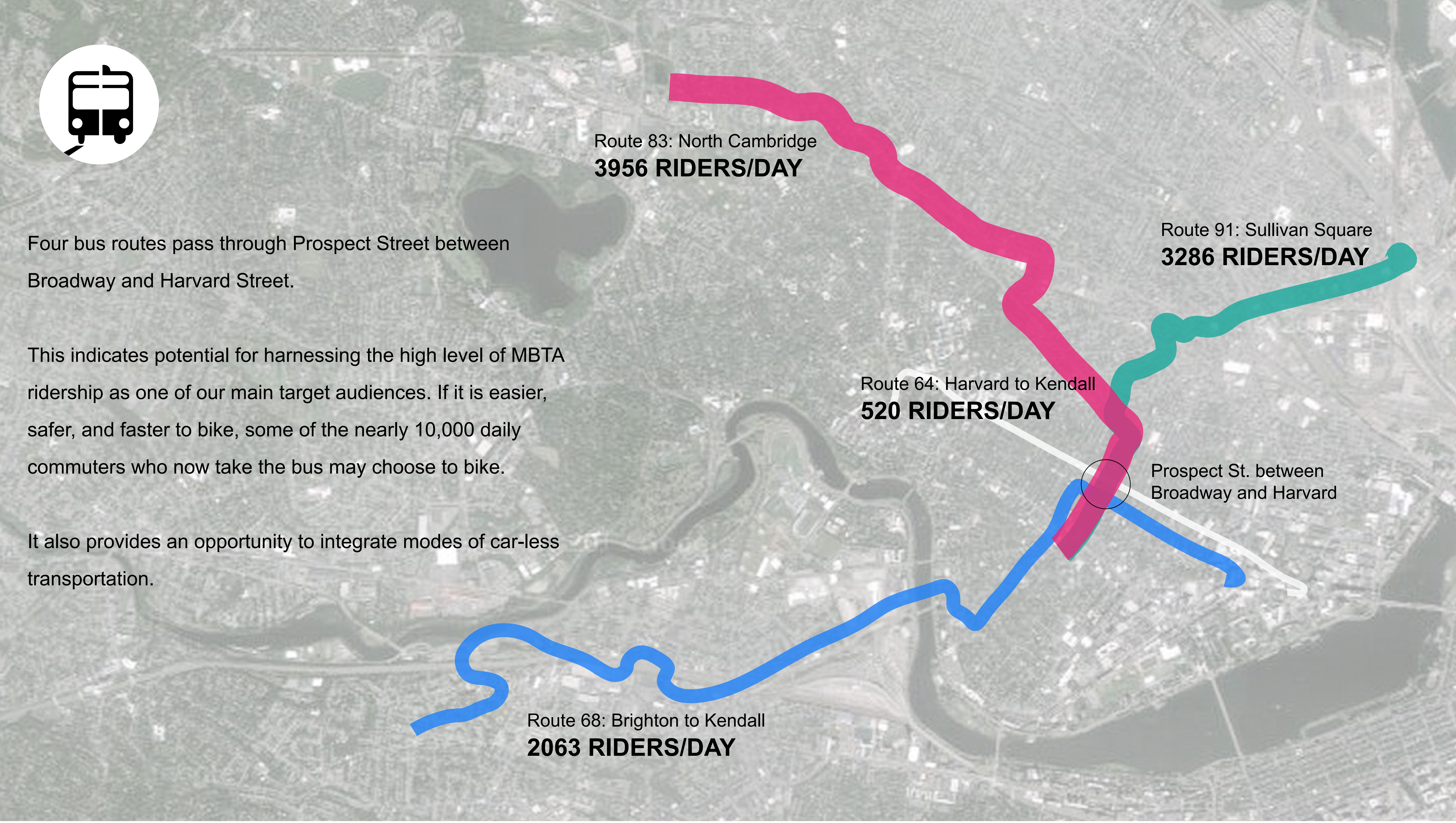
04 **IMPROVING BIKE SAFETY**
shared space reduces casualties by 15-20%

05 **LIMITING CAPACITY REDUCTION**
maintaining 300 vehicles/hour and 200 bicycles/hour

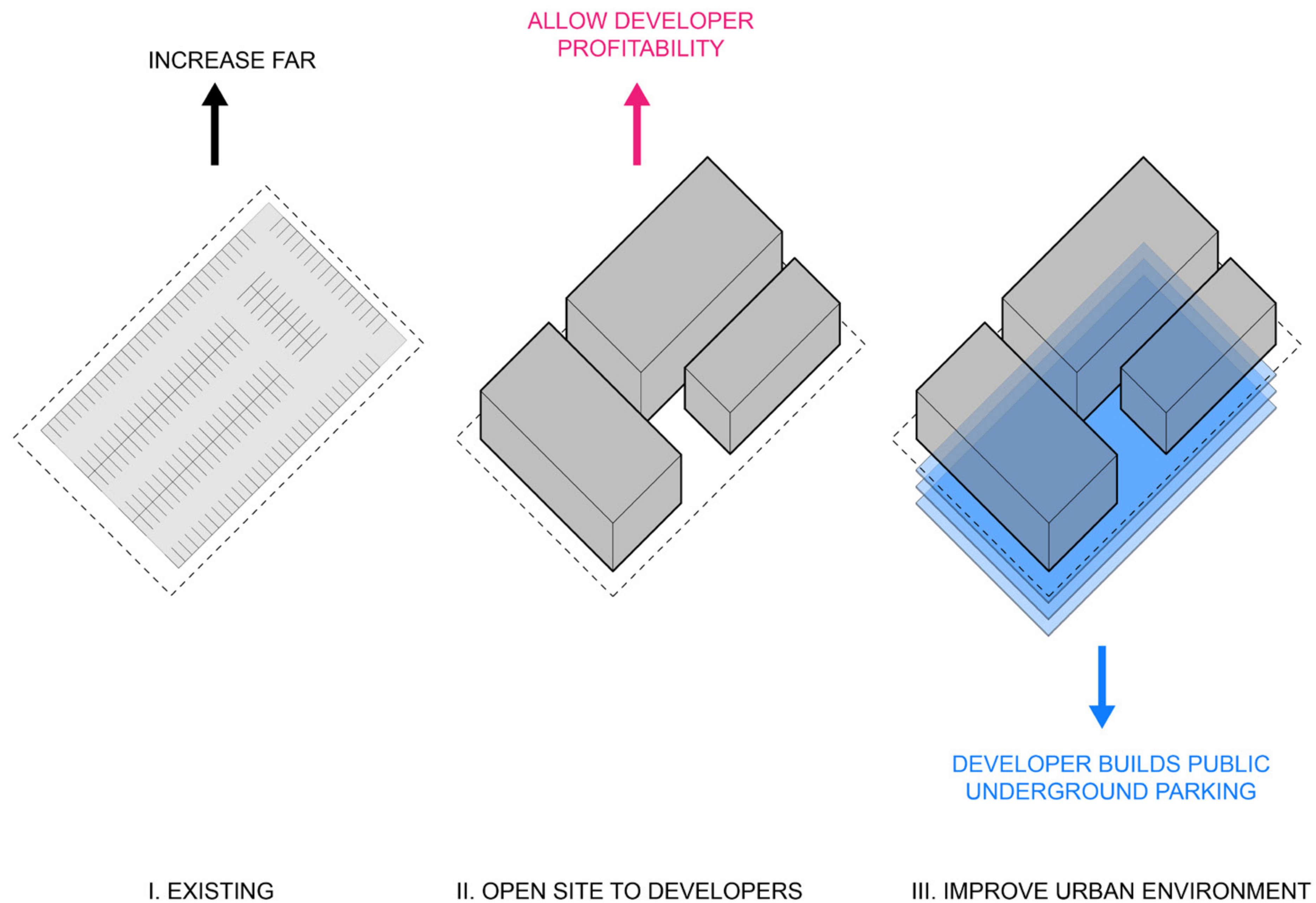
Four bus routes pass through Prospect Street between Broadway and Harvard Street.

This indicates potential for harnessing the high level of MBTA ridership as one of our main target audiences. If it is easier, safer, and faster to bike, some of the nearly 10,000 daily commuters who now take the bus may choose to bike.

It also provides an opportunity to integrate modes of car-less transportation.



MULTIMODAL APPROACH

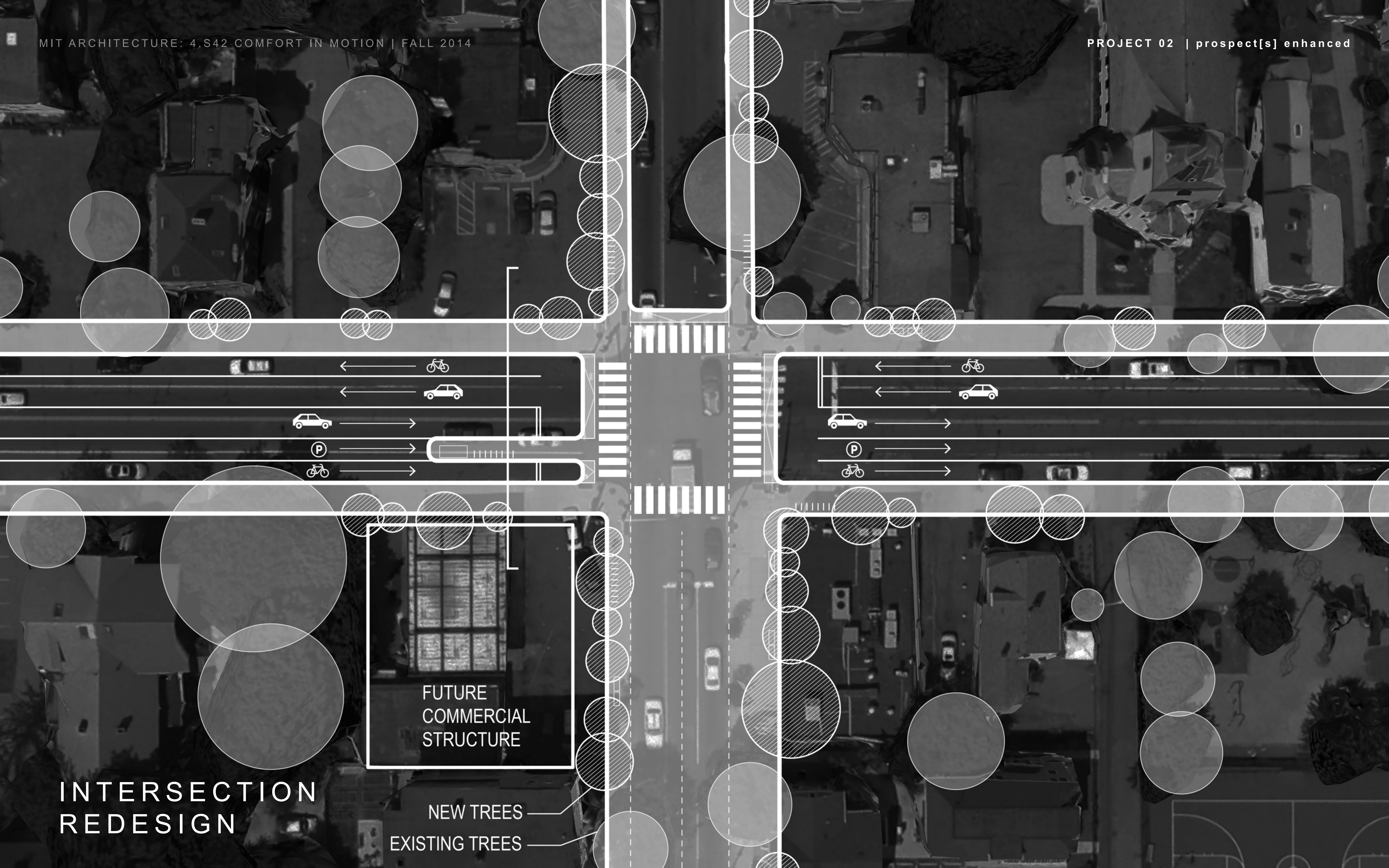


PROFITABILITY & PARKING

01 INTERSECTION REDESIGN

BROADWAY ST | CURRENT CONDITION

BROADWAY ST AT PROSPECT ST | CURRENT CONDITION

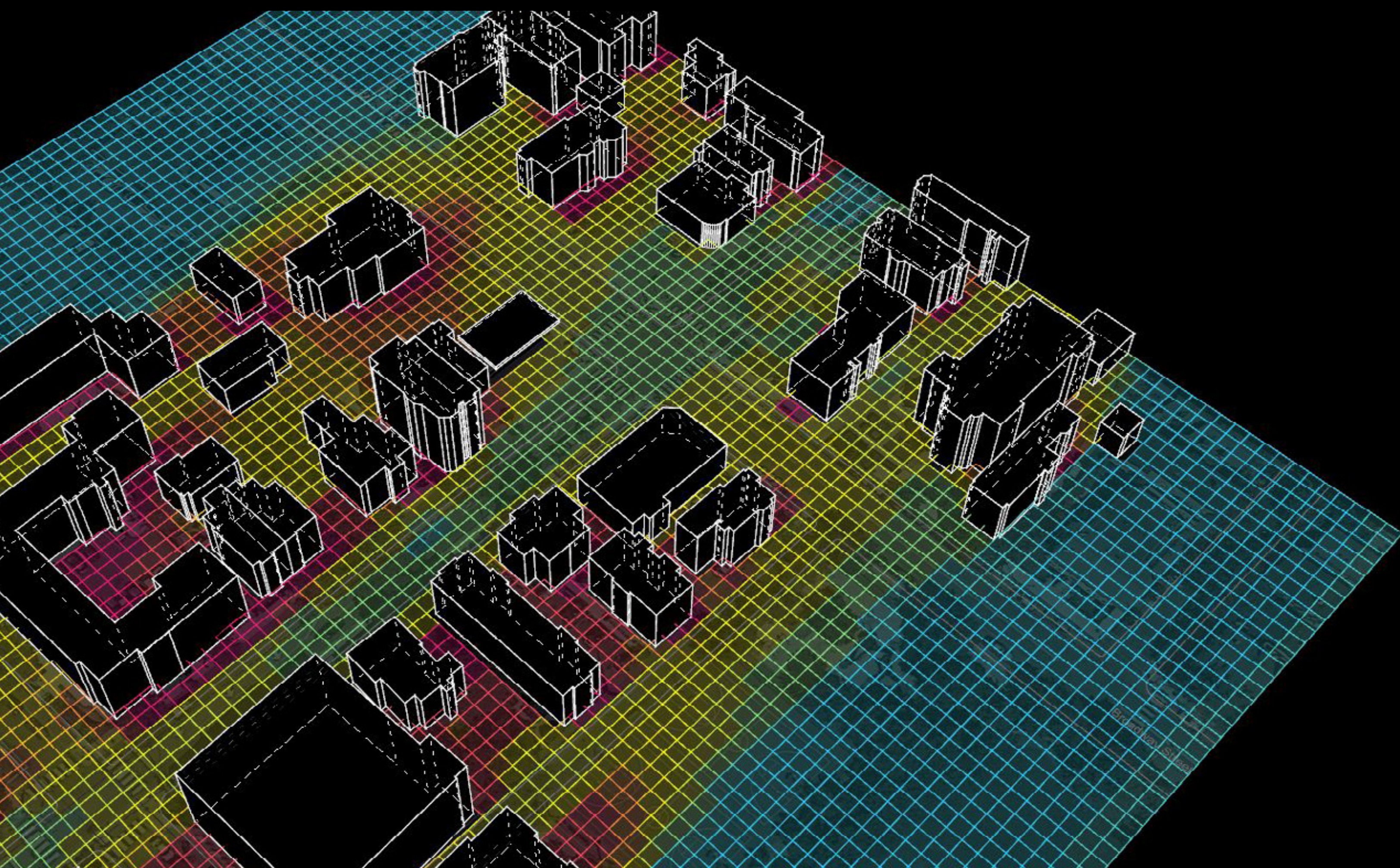


INTERSECTION REDESIGN

INTERSECTION REDESIGN

-3 0 +3

cold neutral warm



EXISTING MICROCLIMATE

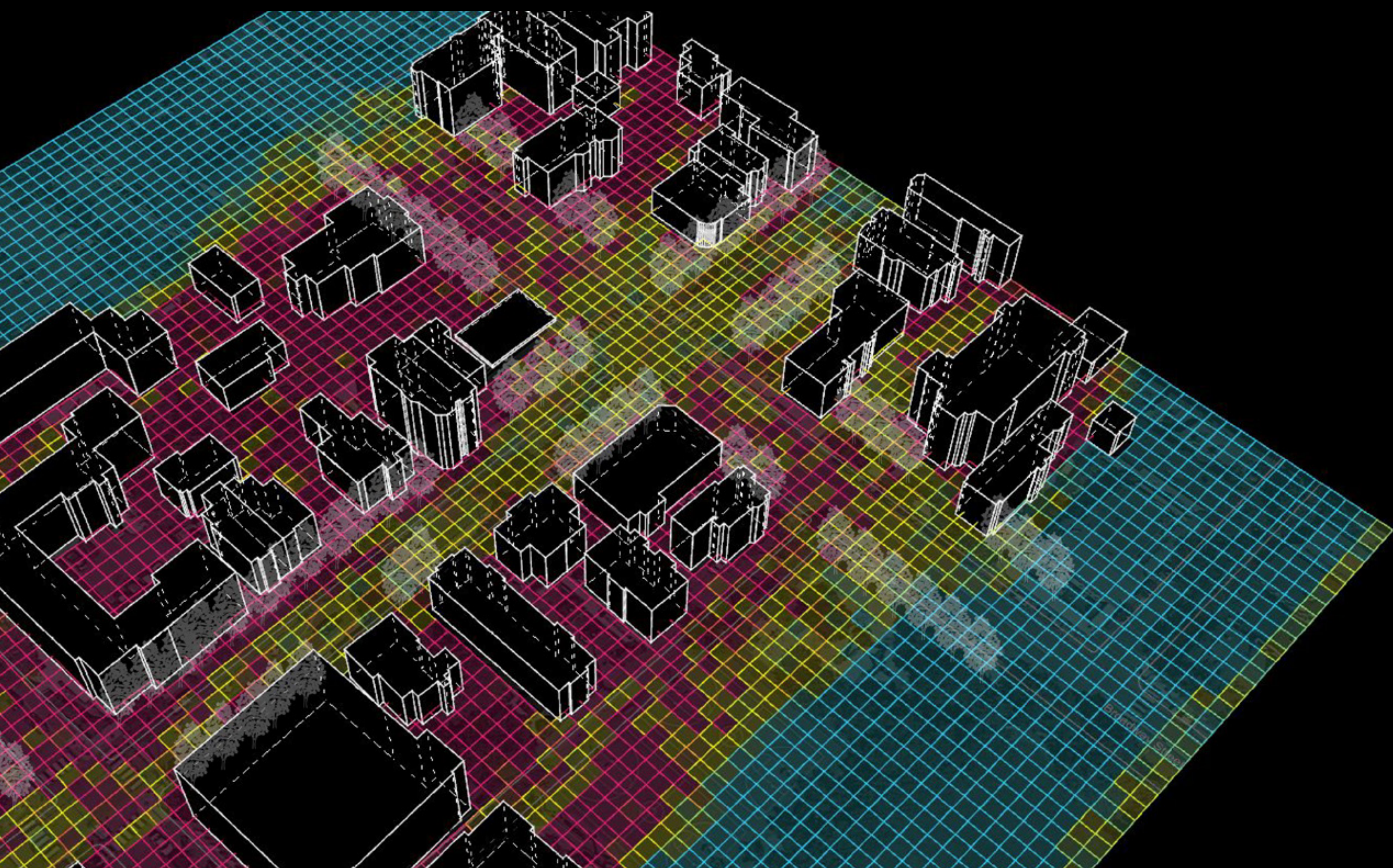
predicted mean vote (comfort metric)
mapped on street and bike lanes

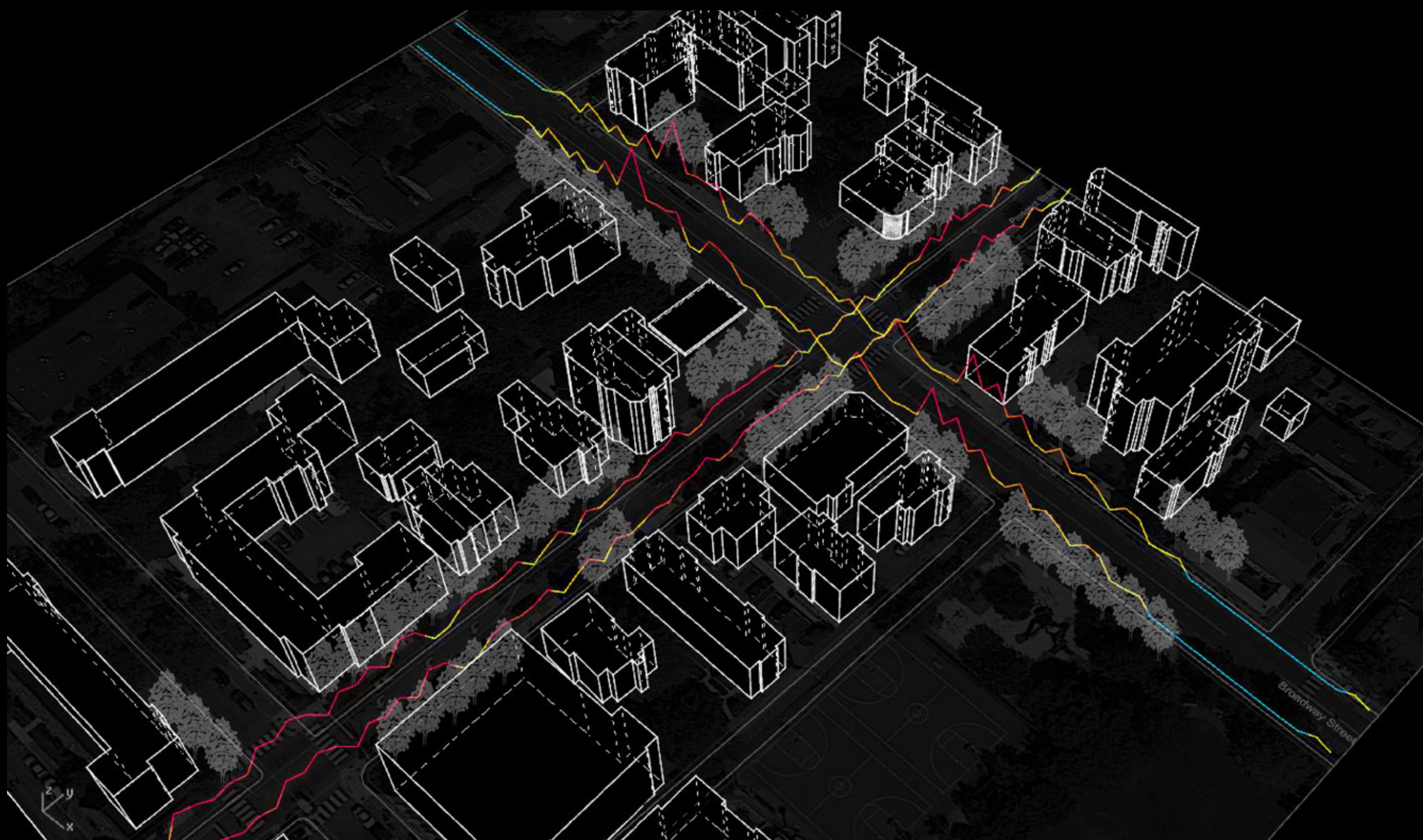
AVG. PMV november **-2.46** cold

AVG. PMV march **-1.77** cool

-3 0 +3

cold neutral warm





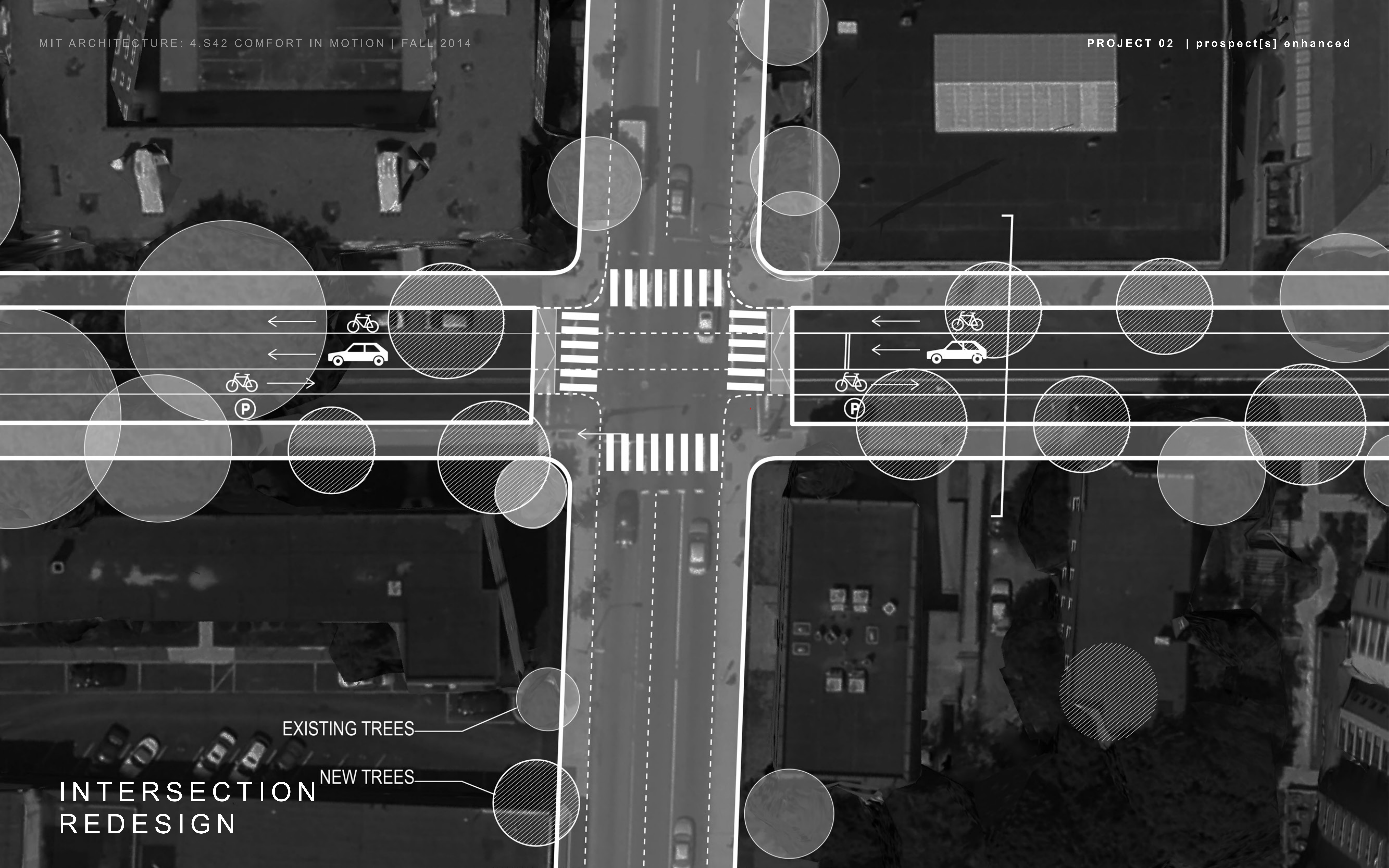
ENHANCED MICROCLIMATE

enhanced predicted mean vote values
after the integration of foliage and new materials

AVG. PMV november	**-1.46**	**cool**	**42% improvement**
AVG. PMV march	**-0.87**	**neutral**	**51% improvement**

02 INTERSECTION REDESIGN

HARVARD ST | CURRENT CONDITION



INTERSECTION REDESIGN

INTERSECTION REDESIGN

VIBRANT

improve community life through developing an active corridor

MULTIMODAL

promote multimodal transit and enhance commuting options

BIKEABLE

improve bikeability with well-planned, higher quality infrastructure

COMFORTABLE

improve outdoor comfort conditions through materials and foliage

ATTRACTIVE

increase real estate potential while maintaining liveability

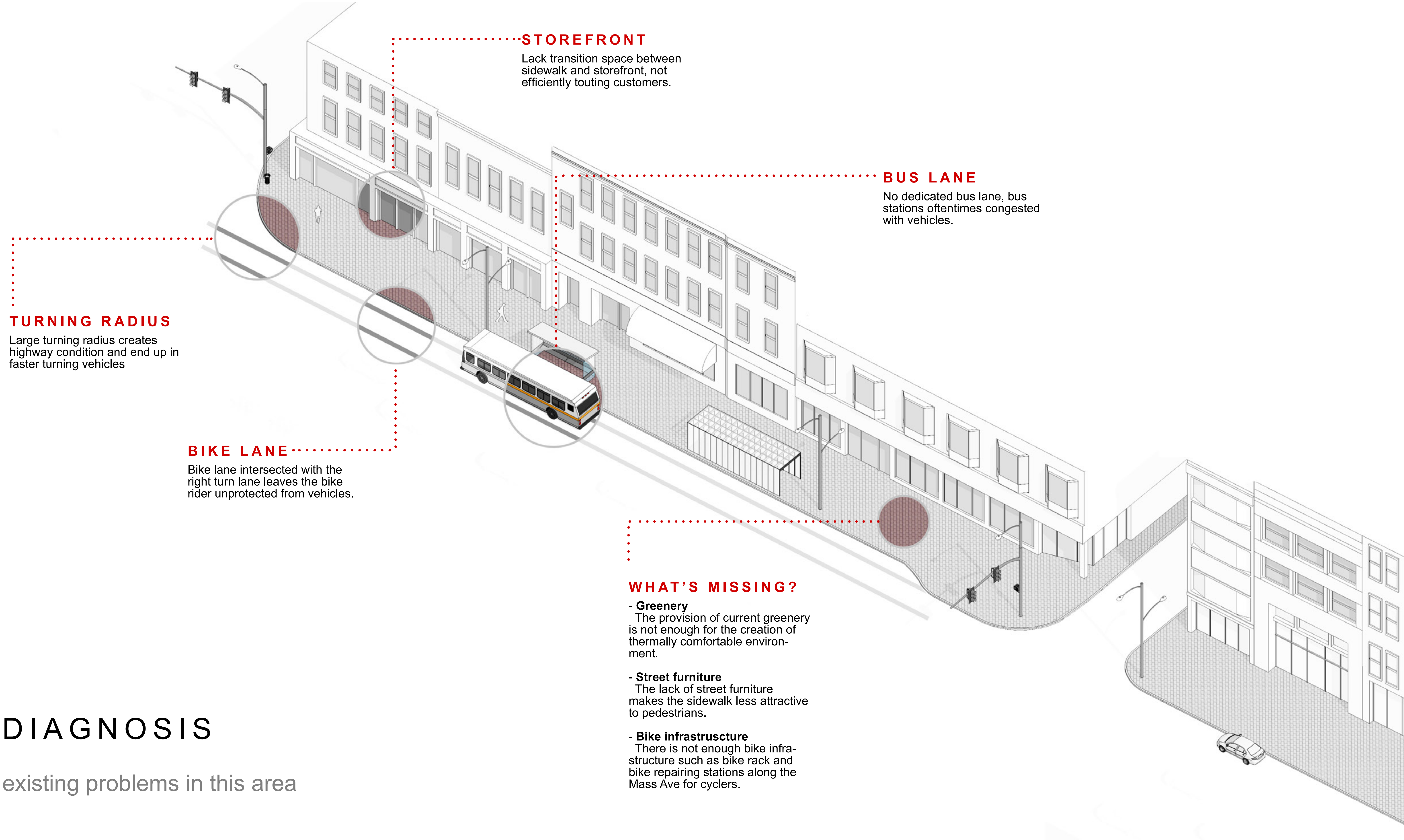
Central Re-envisioned

Advocating Walking, Biking and Public Transit

03

YUE SHAO [MIT UG ARCH], FENG SHEN [HARVARD MAUD]

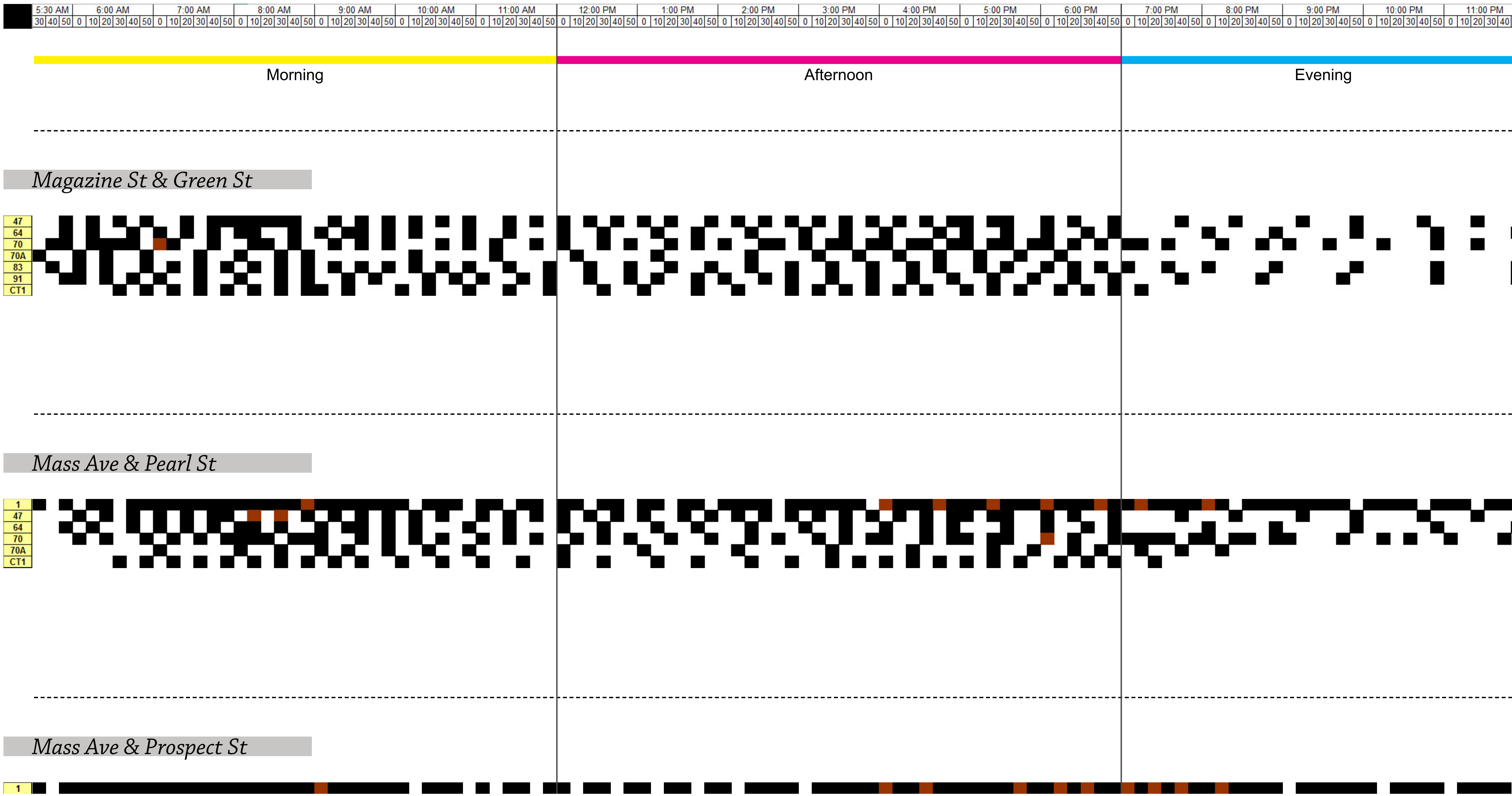

HARVARD
SOMERVILLE
BROADWAY ST
HARVARD ST
PROSPECT ST
MASS AVE
CAMBRIDGEPORT
MIT

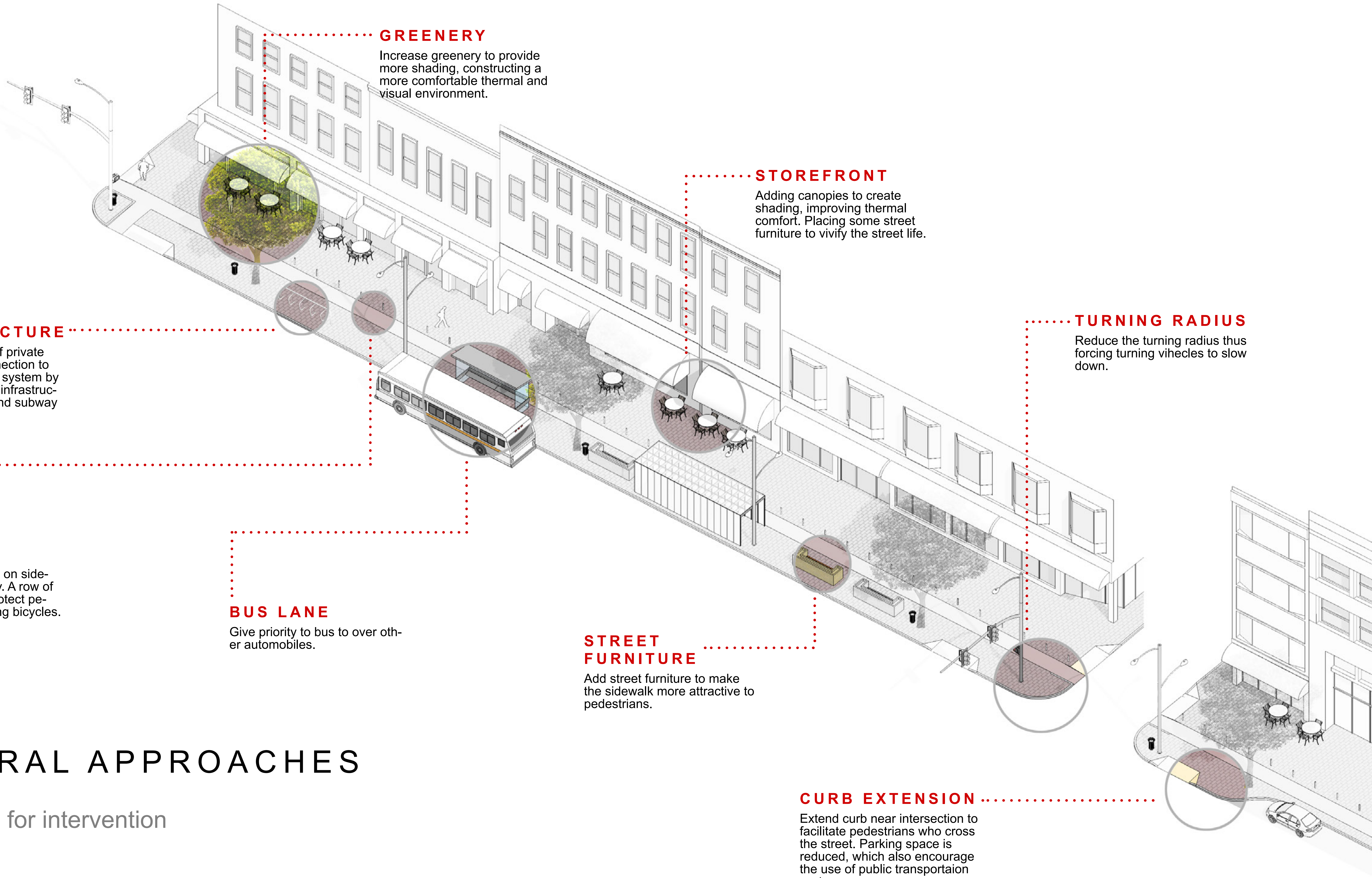


DIAGNOSIS

existing problems in this area


47, 64, 70, 70A,
83, 91, CT1
1
1, 47, 64, 70,
70A, CT1
1
2
3
DIAGNOSIS
congested bus schedule


5:30 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
Morning
Afternoon
Evening
Magazine St & Green St
47
64
70
70A
83
91
CT1
Mass Ave & Pearl St
1
47
64
70
70A
CT1
Mass Ave & Prospect St
1



GREENERY

Increase greenery to provide more shading, constructing a more comfortable thermal and visual environment.

STOREFRONT

Adding canopies to create shading, improving thermal comfort. Placing some street furniture to vivify the street life.

BIKE INFRASTRUCTURE

Promote utilization of private bicycles and its connection to public transportation system by adding more bicycle infrastructure near bus stop and subway stations.

TURNING RADIUS

Reduce the turning radius thus forcing turning vihecles to slow down.

BIKE LANE

Placing the bike lane on sidewalk to ensure safety. A row of bars are added to protect pedestrians from running bicycles.

BUS LANE

Give priority to bus to over other automobiles.

STREET FURNITURE

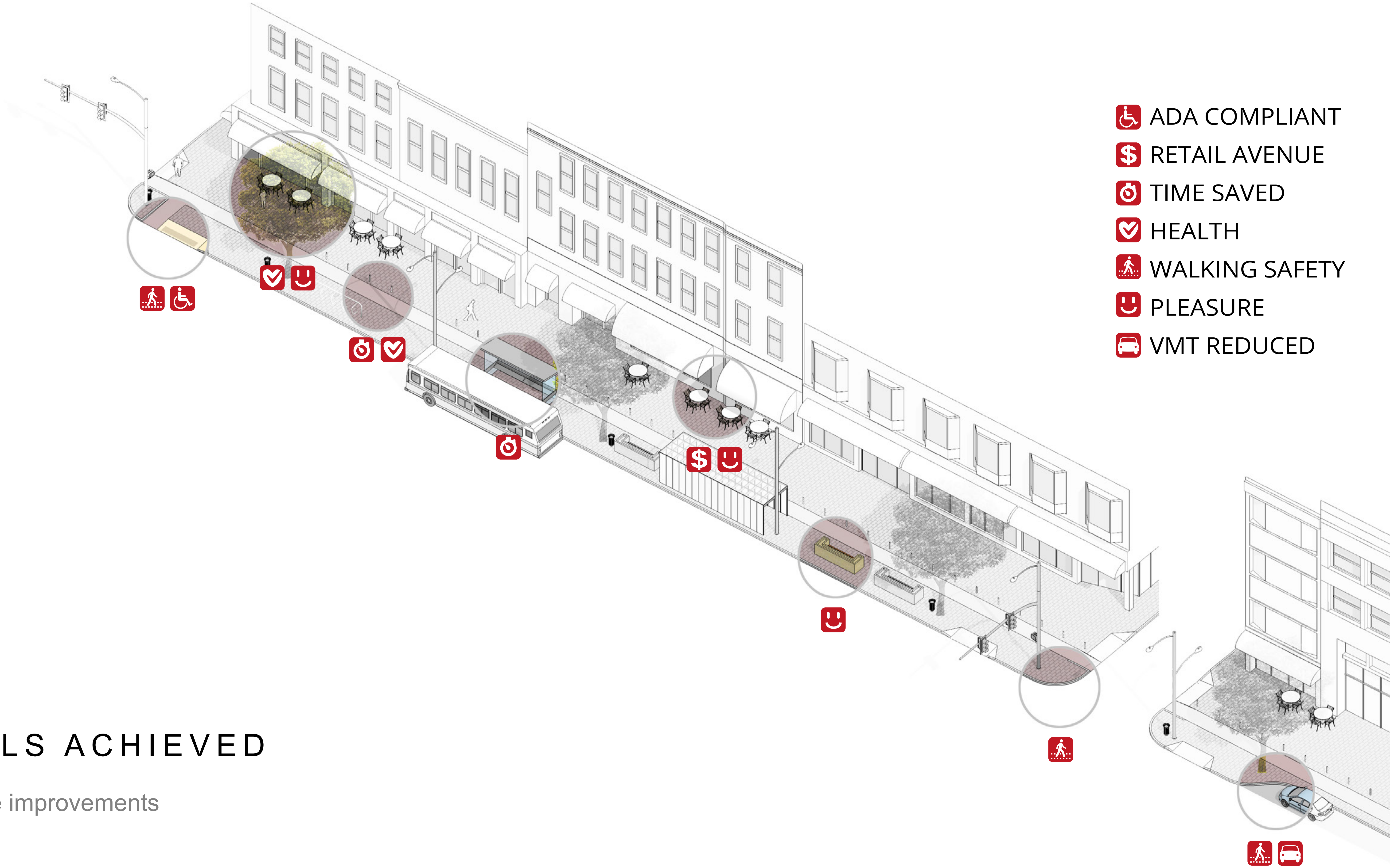
Add street furniture to make the sidewalk more attractive to pedestrians.

CURB EXTENSION

Extend curb near intersection to facilitate pedestrians who cross the street. Parking space is reduced, which also encourage the use of public transportaion system.

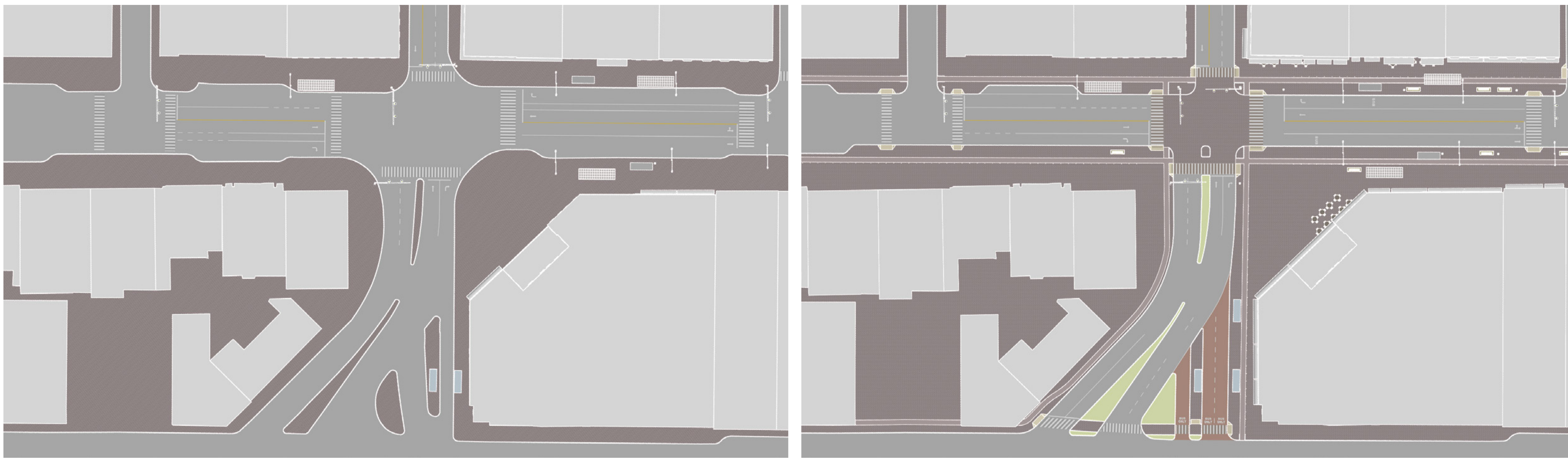
GENERAL APPROACHES

a guideline for intervention



GOALS ACHIEVED

possible improvements



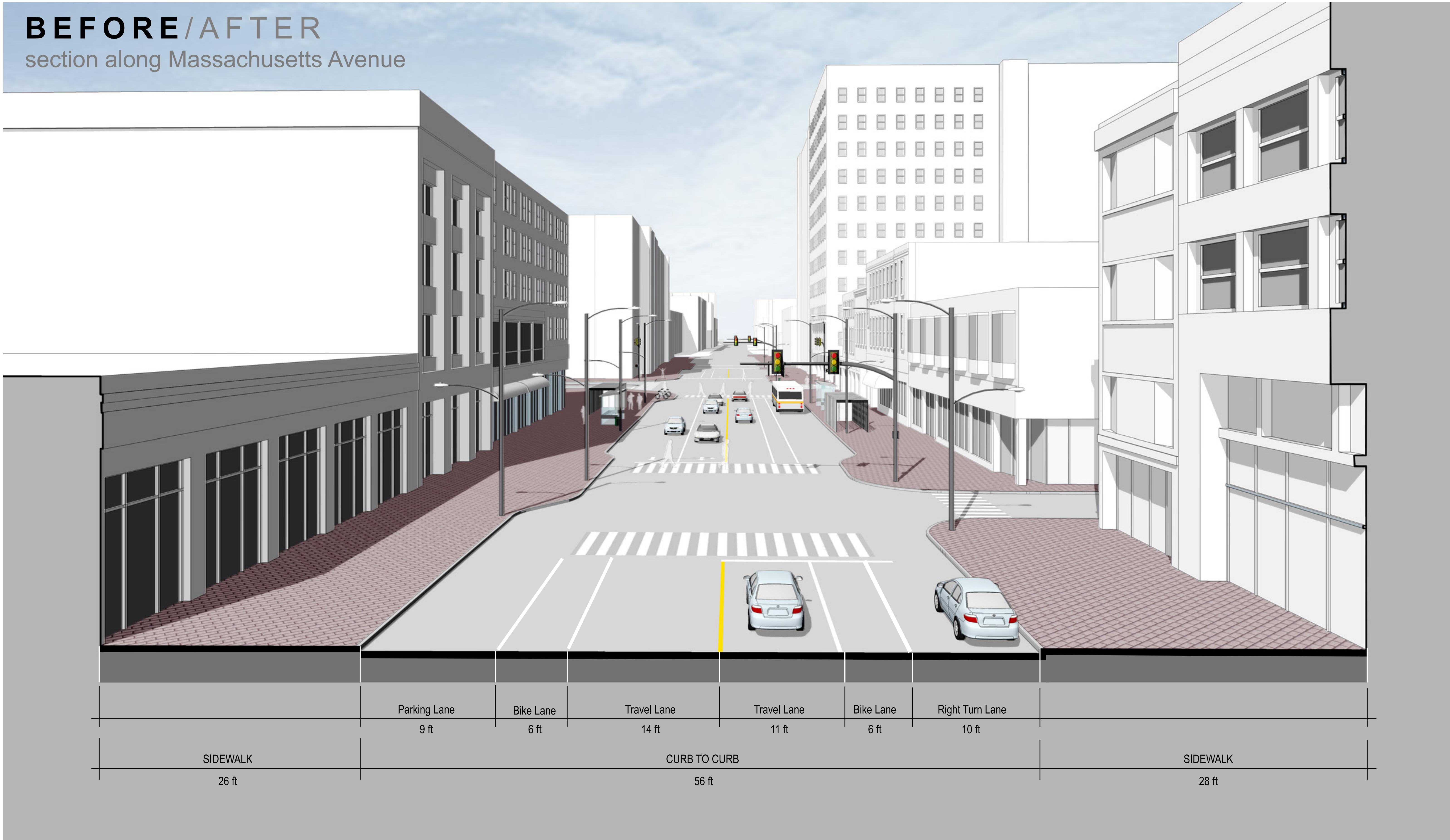
BEFORE/AFTER

boundary of intervention

BEFORE/AFTER

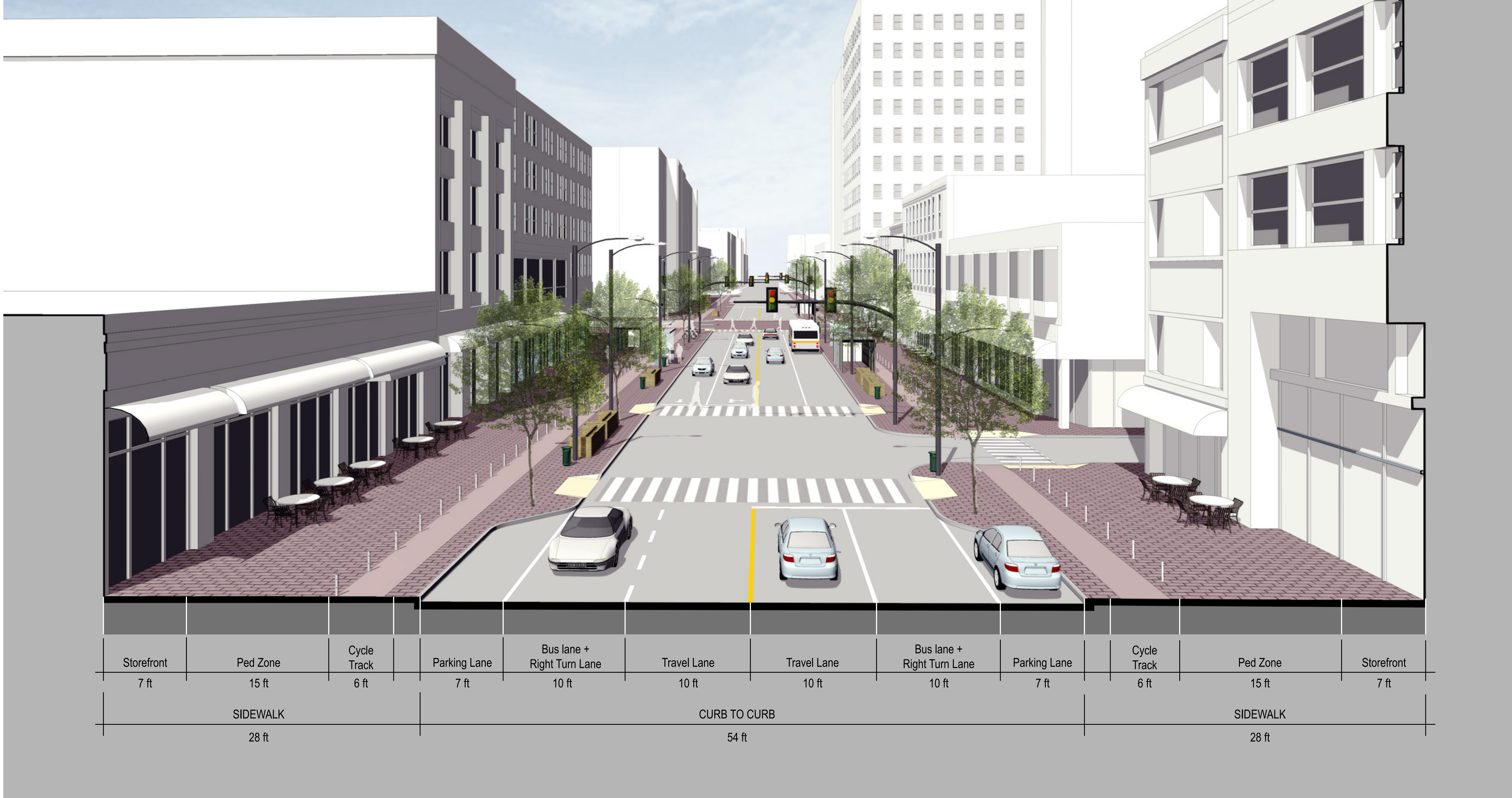
section along Massachusetts Avenue

BEFORE/AFTER
section along Massachusetts Avenue



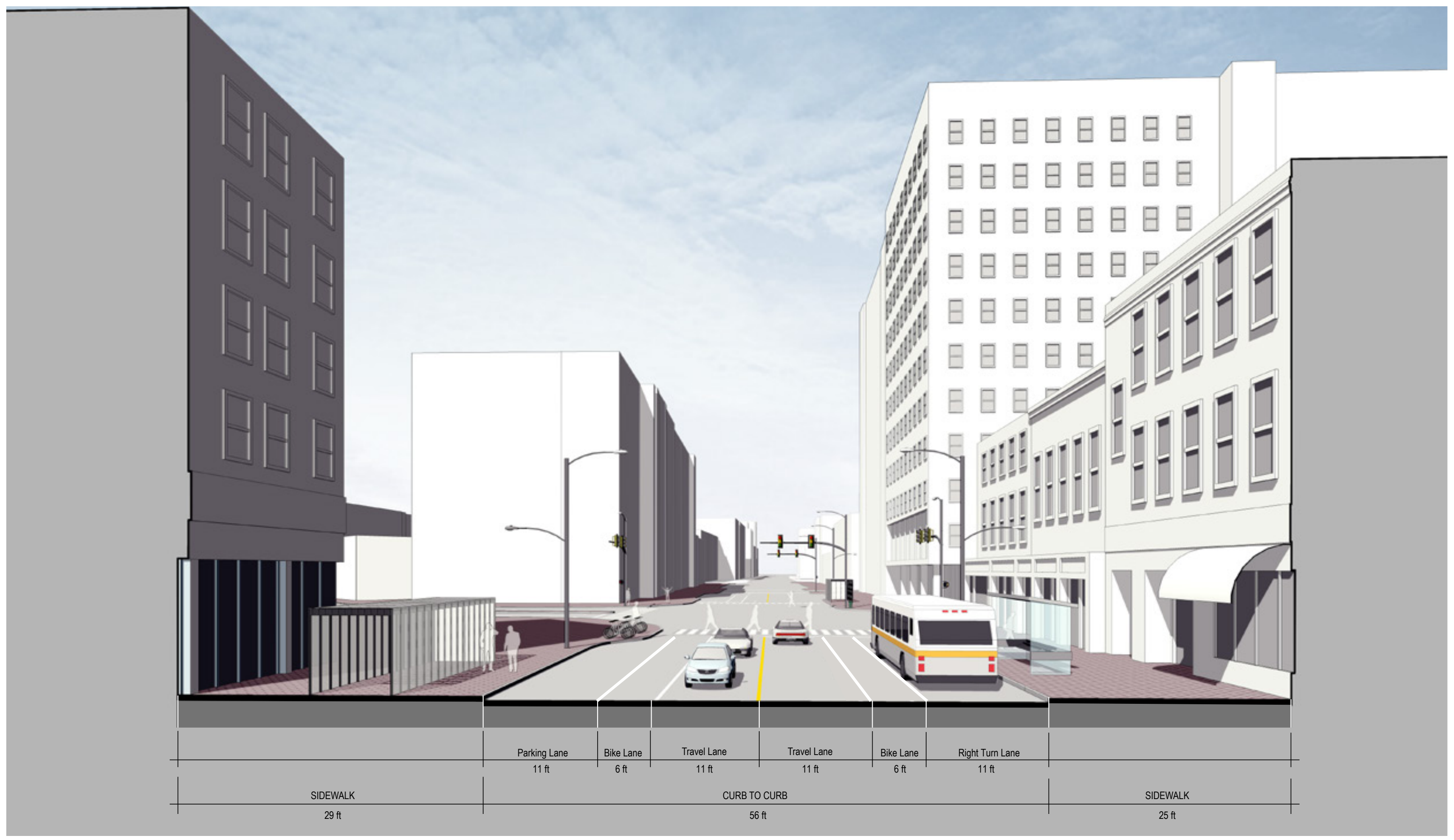
BEFORE/**AFTER**

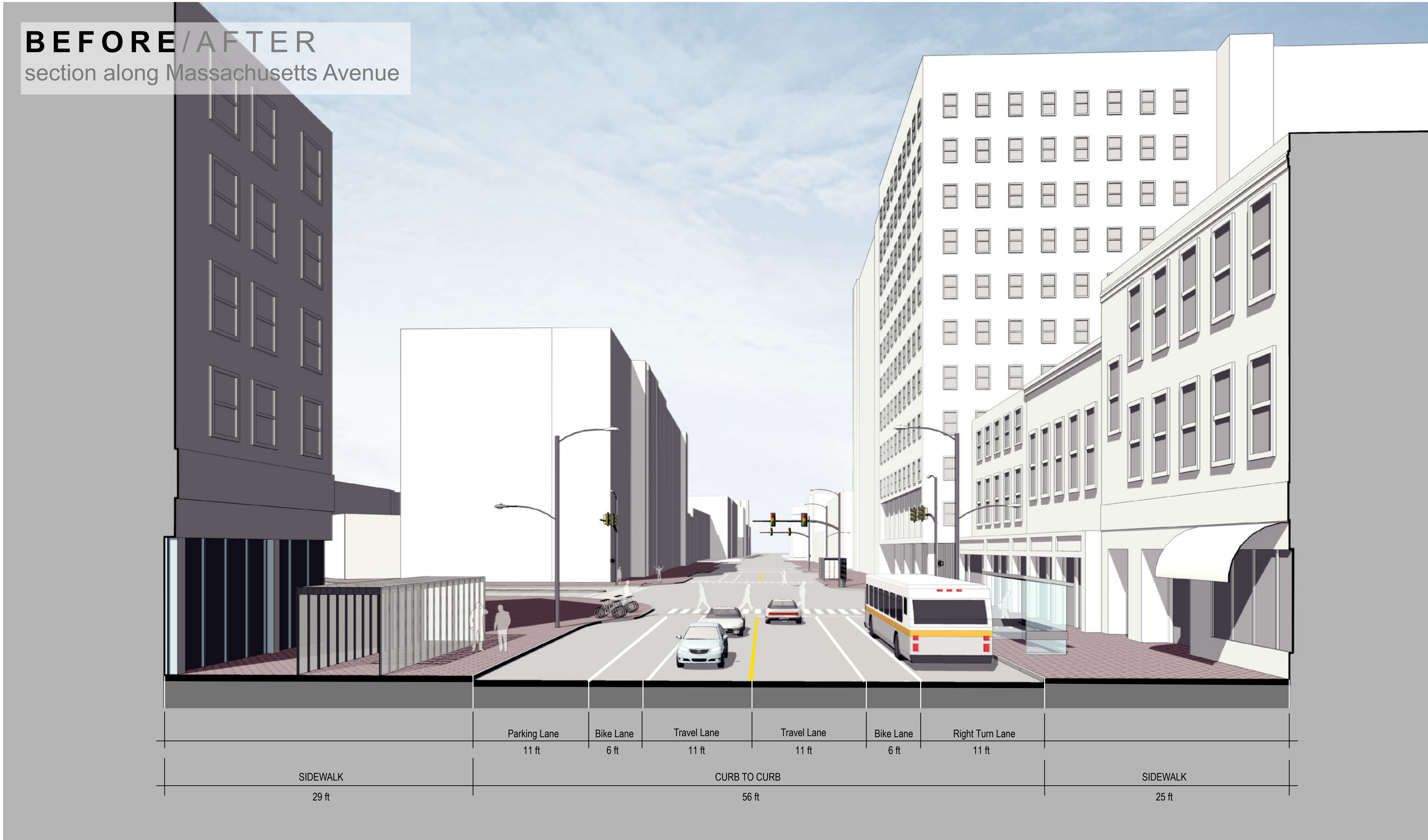
section along Massachusetts Avenue



BEFORE/AFTER

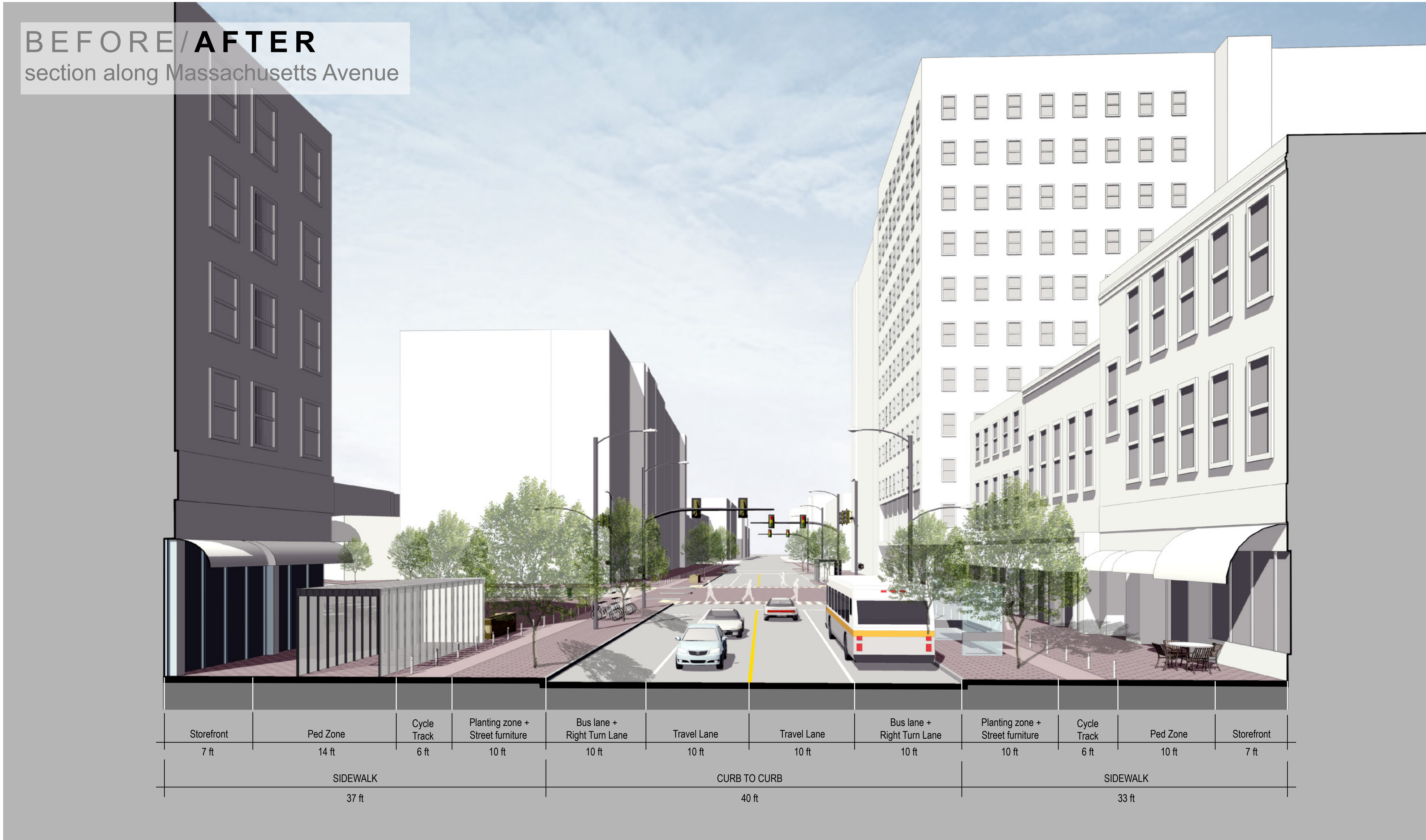
section along Massachusetts Avenue




BEFORE/AFTER
section along Massachusetts Avenue
Parking Lane
11 ft
Bike Lane
6 ft
Travel Lane
11 ft
Travel Lane
11 ft
Bike Lane
6 ft
Right Turn Lane
11 ft
SIDEWALK
29 ft
CURB TO CURB
56 ft
SIDEWALK
25 ft

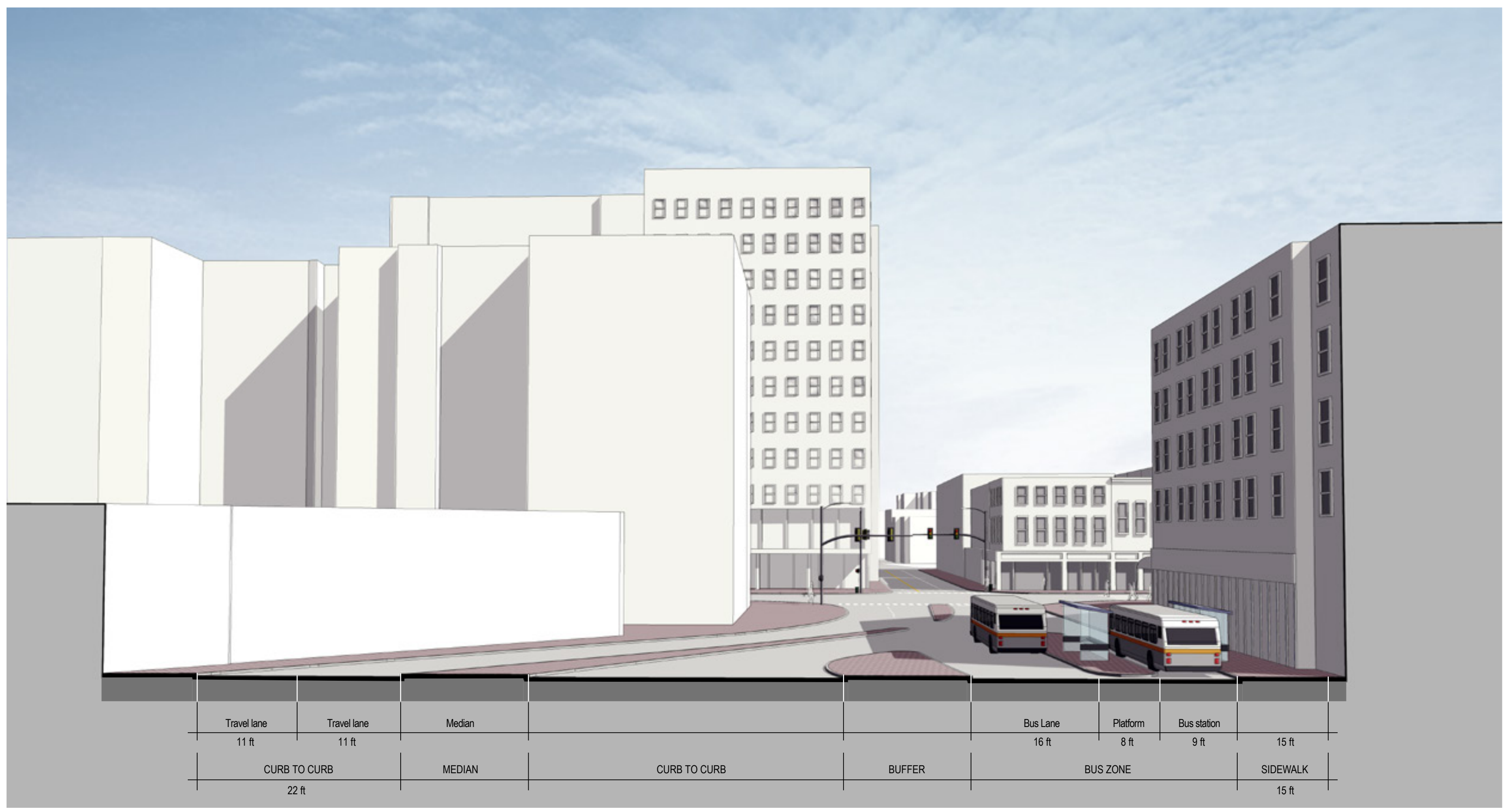
BEFORE/**AFTER**

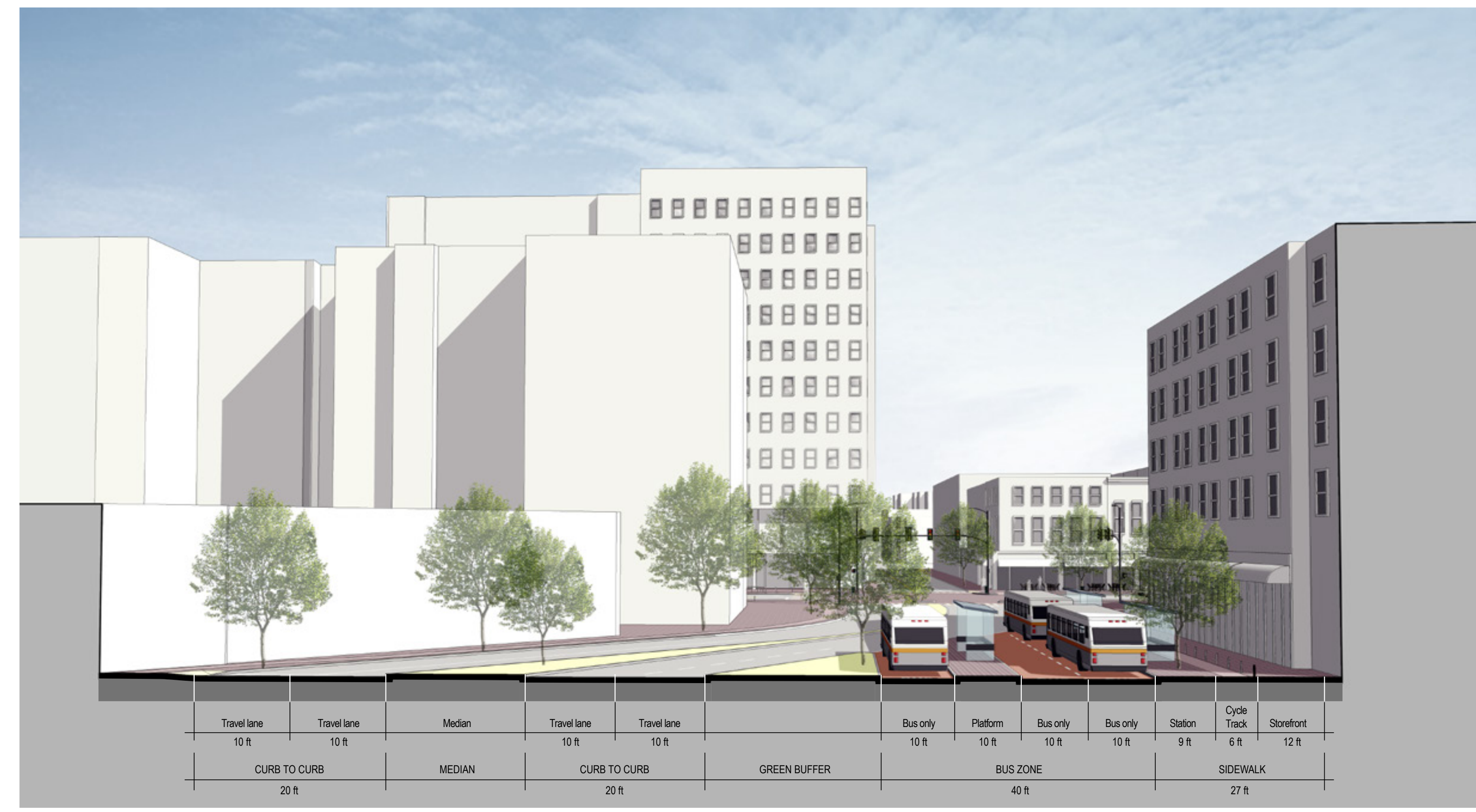
section along Massachusetts Avenue

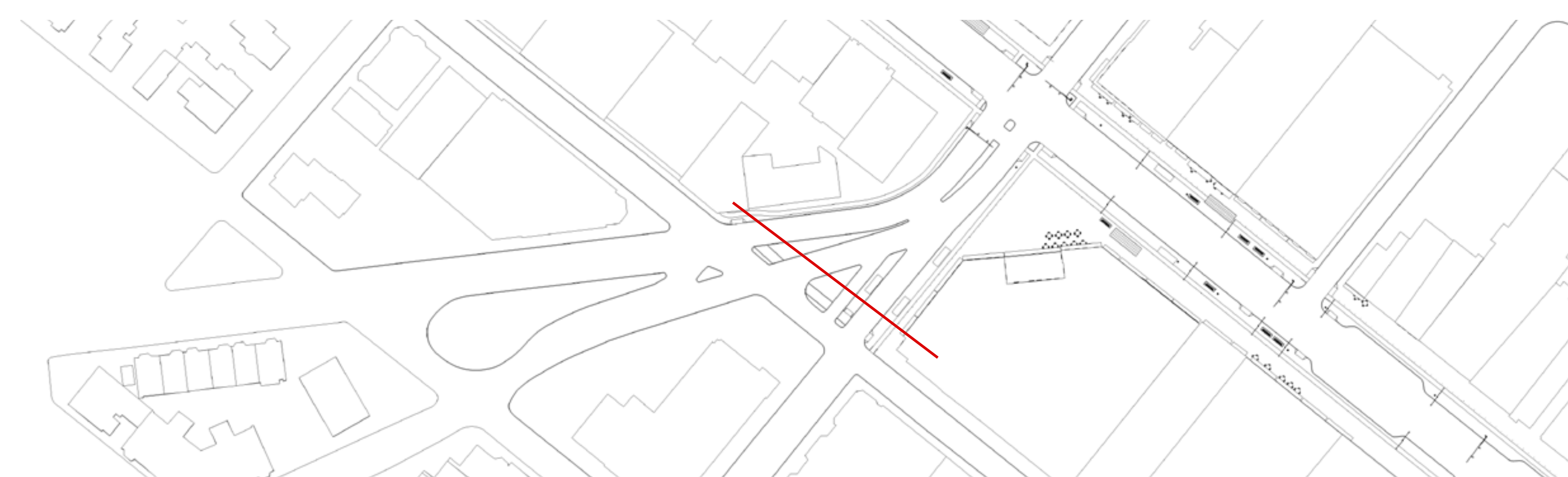


BEFORE/AFTER

section along Western Avenue

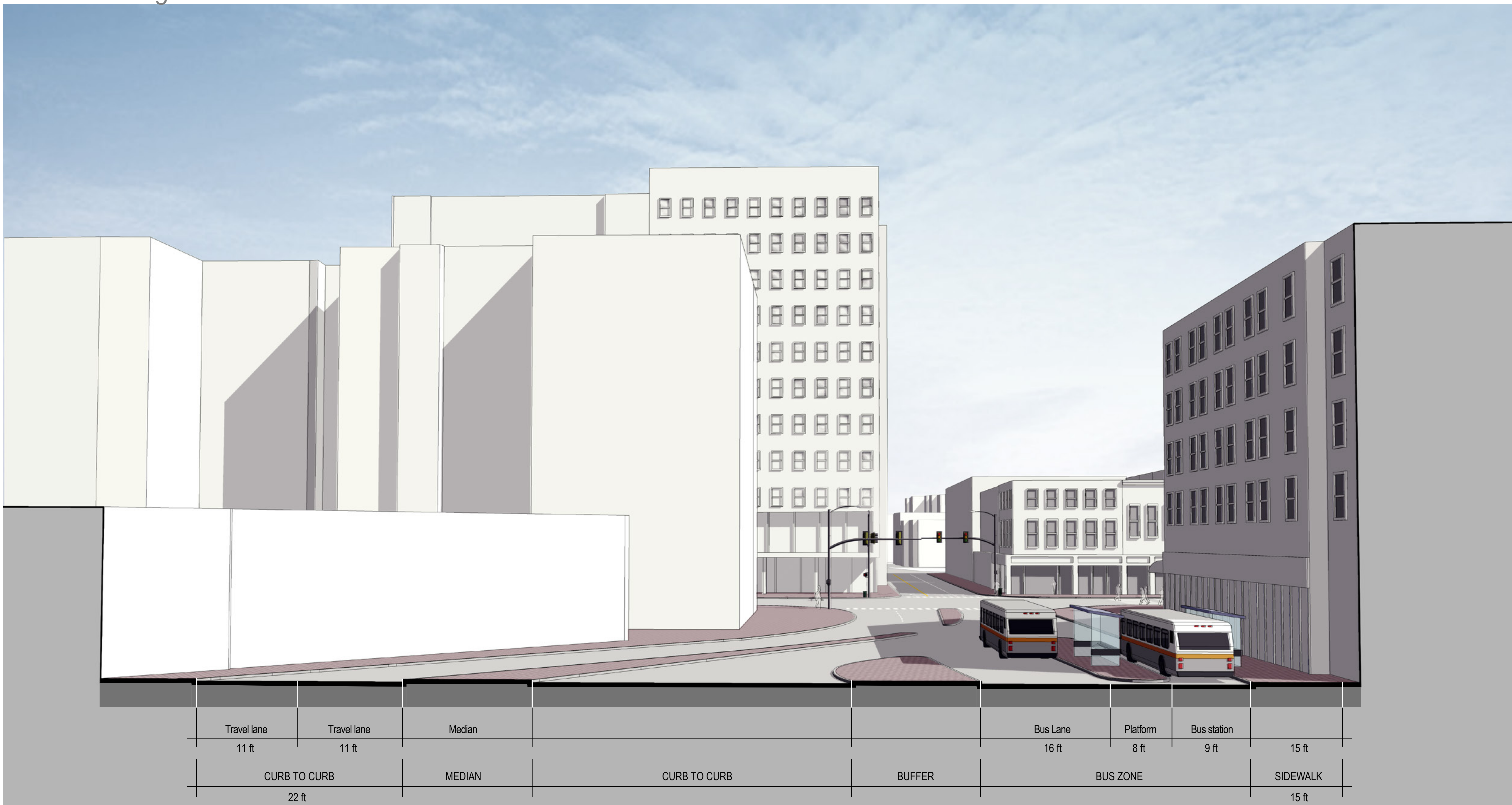






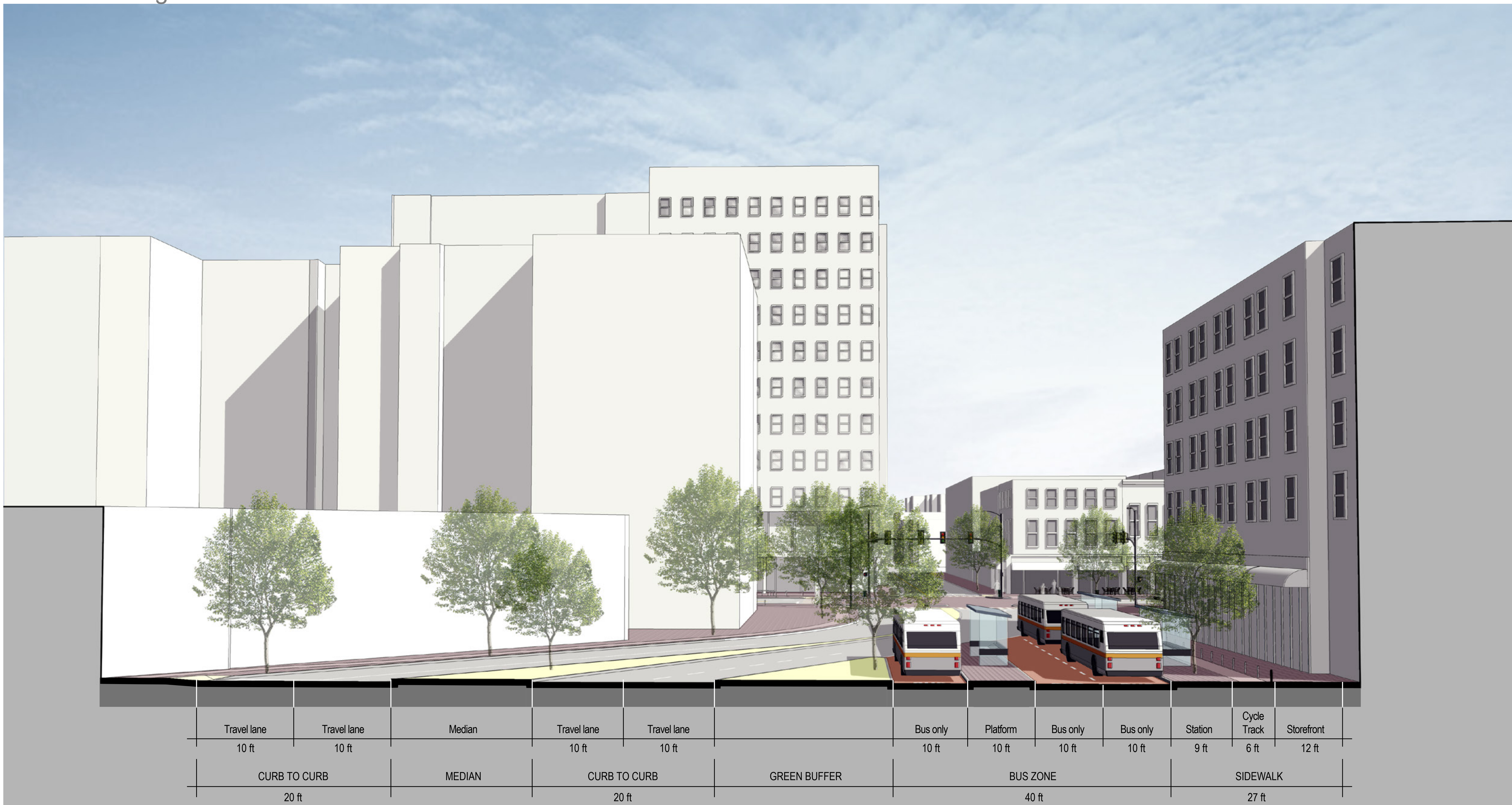
BEFORE/AFTER

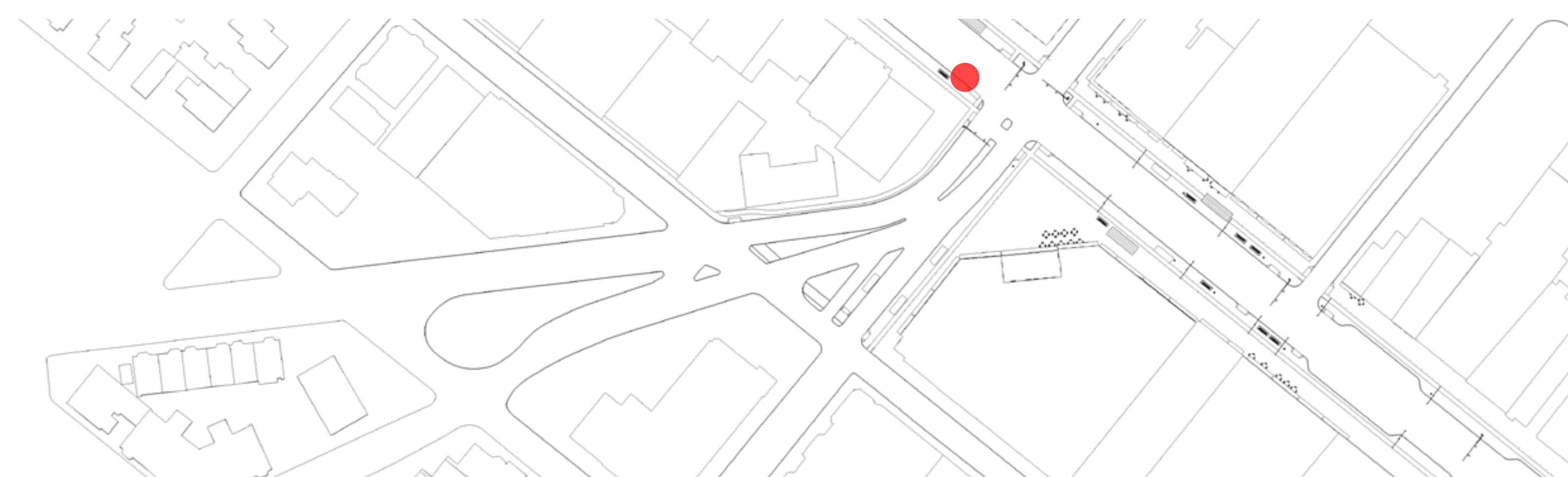
section along Western Avenue



BEFORE/**AFTER**

section along Western Avenue





BEFORE/AFTER

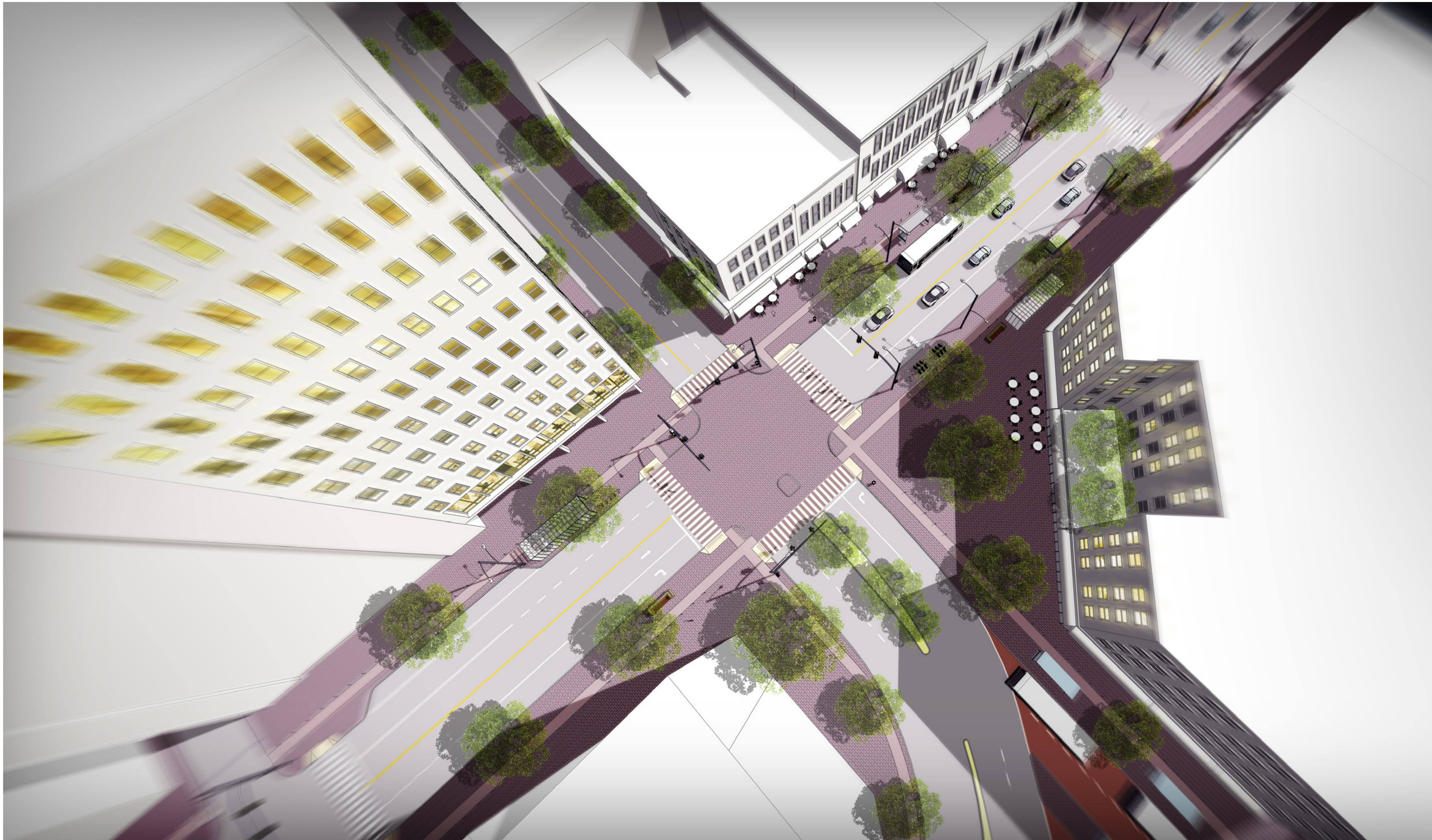
central square intersection

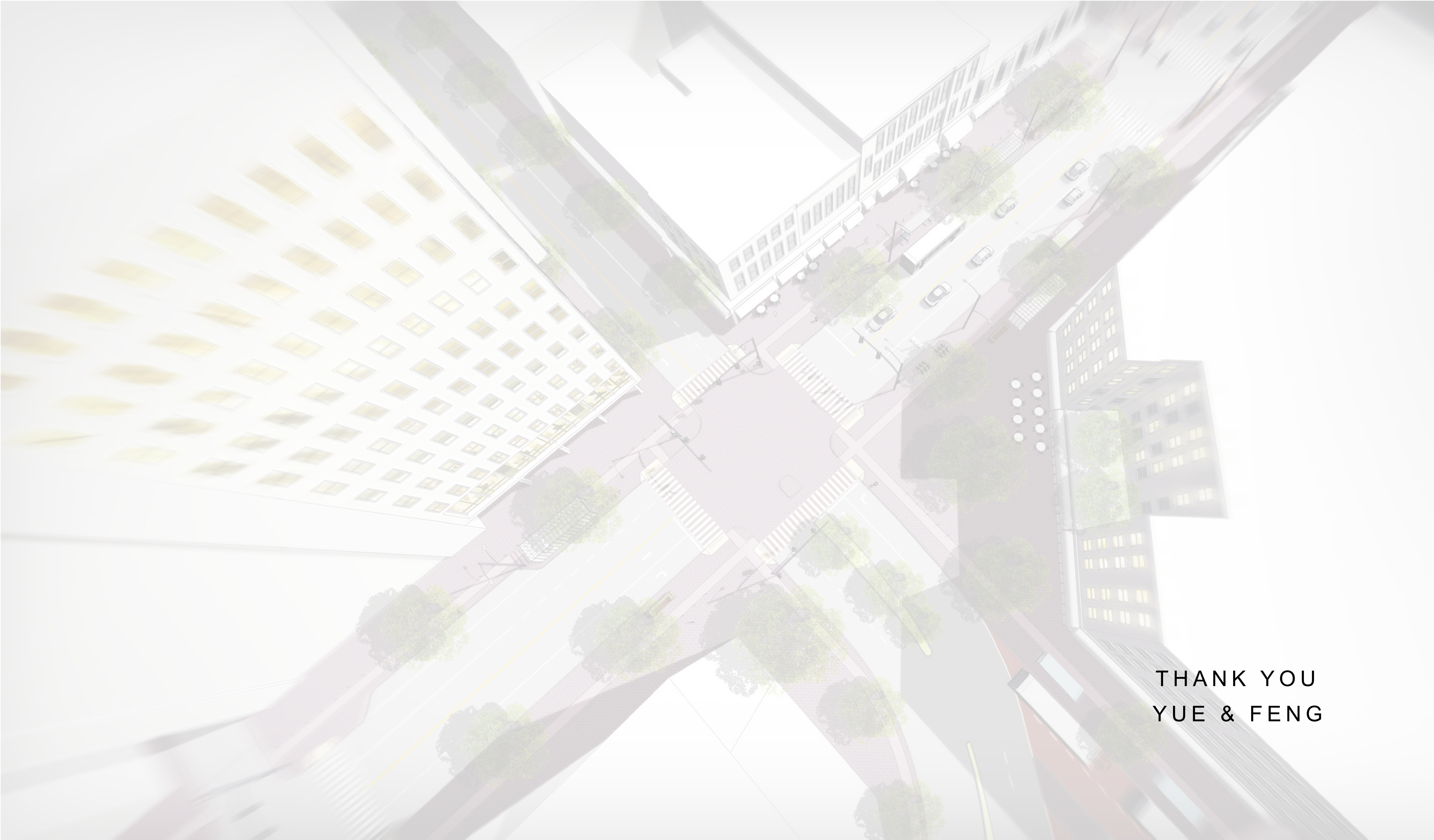
BEFORE/AFTER

Mass Ave at Essex Street

BEFORE/AFTER

Mass Ave





THANK YOU

YUE & FENG

HARVARD SQ^2

[re]Purpose

CHINGWEN HSIAO [HARVARD MDES], TOON VIROCHPOKA [HARVARD MDES], LIUWEI ZHAO [HARVARD MDES]

04


HARVARD
SOMERVILLE
BROADWAY ST
HARVARD ST
PROSPECT ST
MASS AVE
CAMBRIDGEPORT
MIT

SITE

location boundaries

Car/bike direction

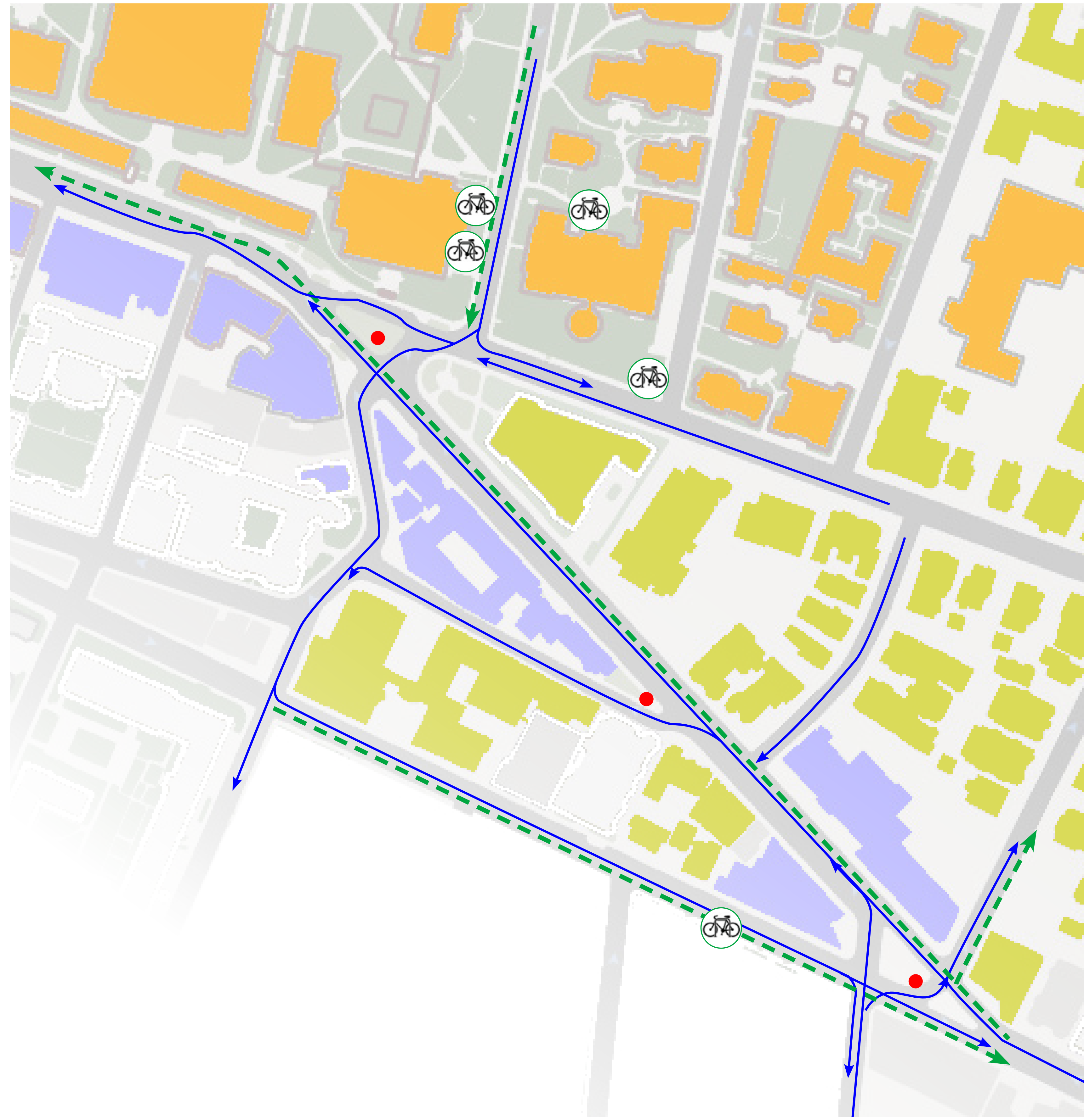
Bike lanes

Bike racks

Residential buildings

Retail buildings

Harvard buildings



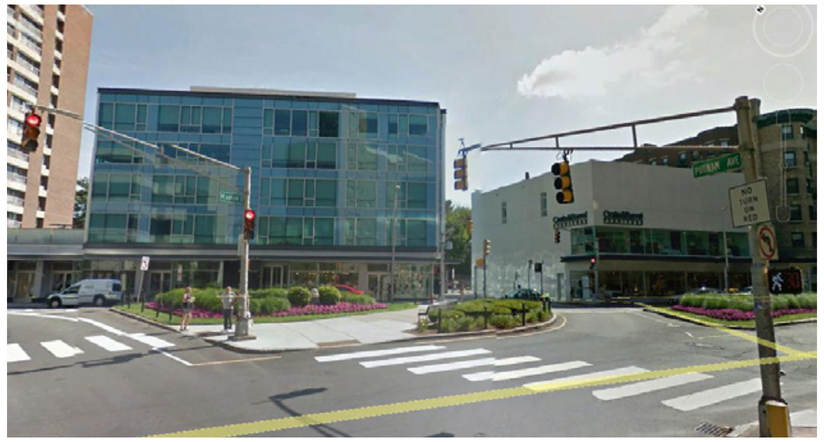
SITE

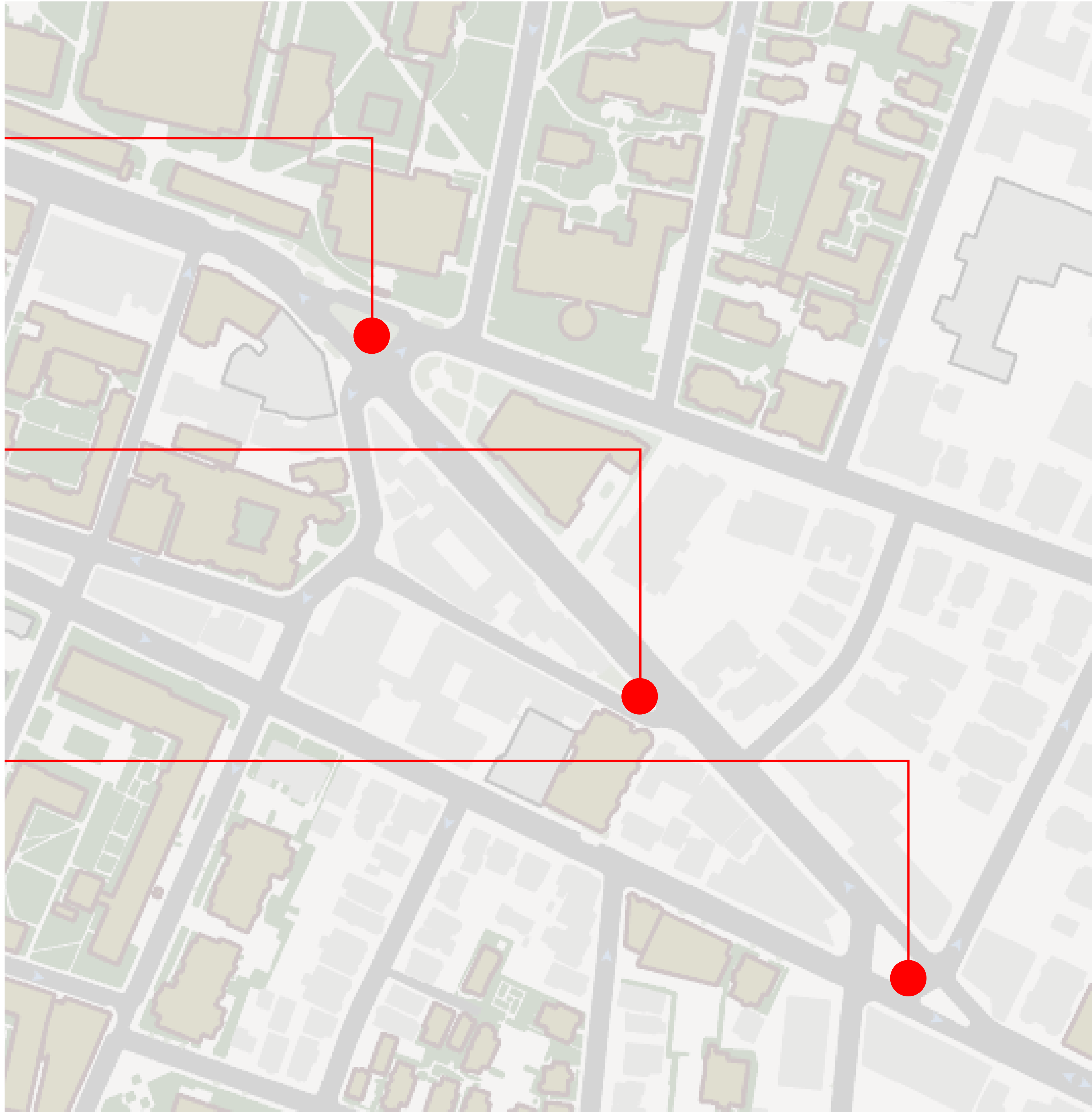
existing circulation

Mass Ave & Quincy St
Confusing direction signal and sequence
No protected bike lanes and racks

Mass Ave & Arrow St
No bike lane and racks on Arrow street
No protected bike crossing
No clear direction signals

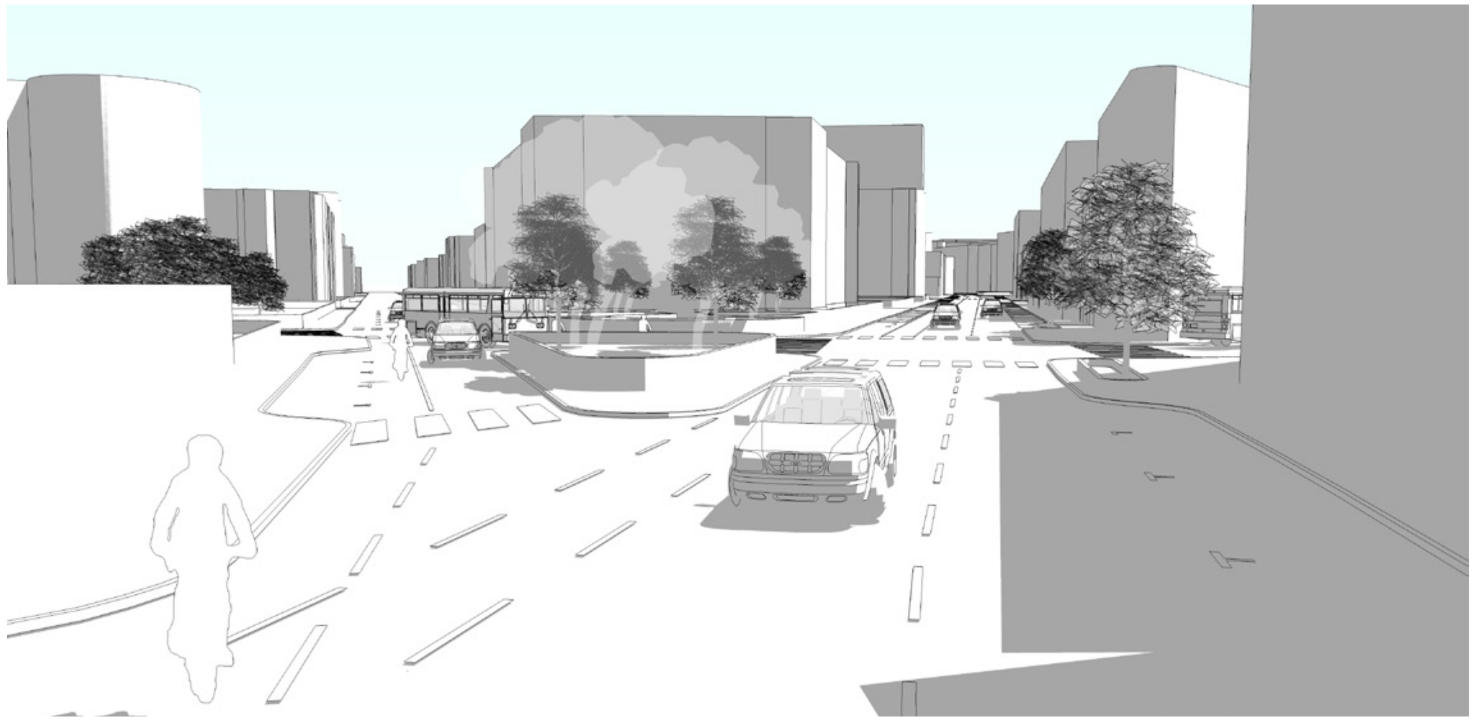
Mass Ave & Putnum Ave
Narrow bike lanes
Bike lanes are not continuous
No protected bike crossing

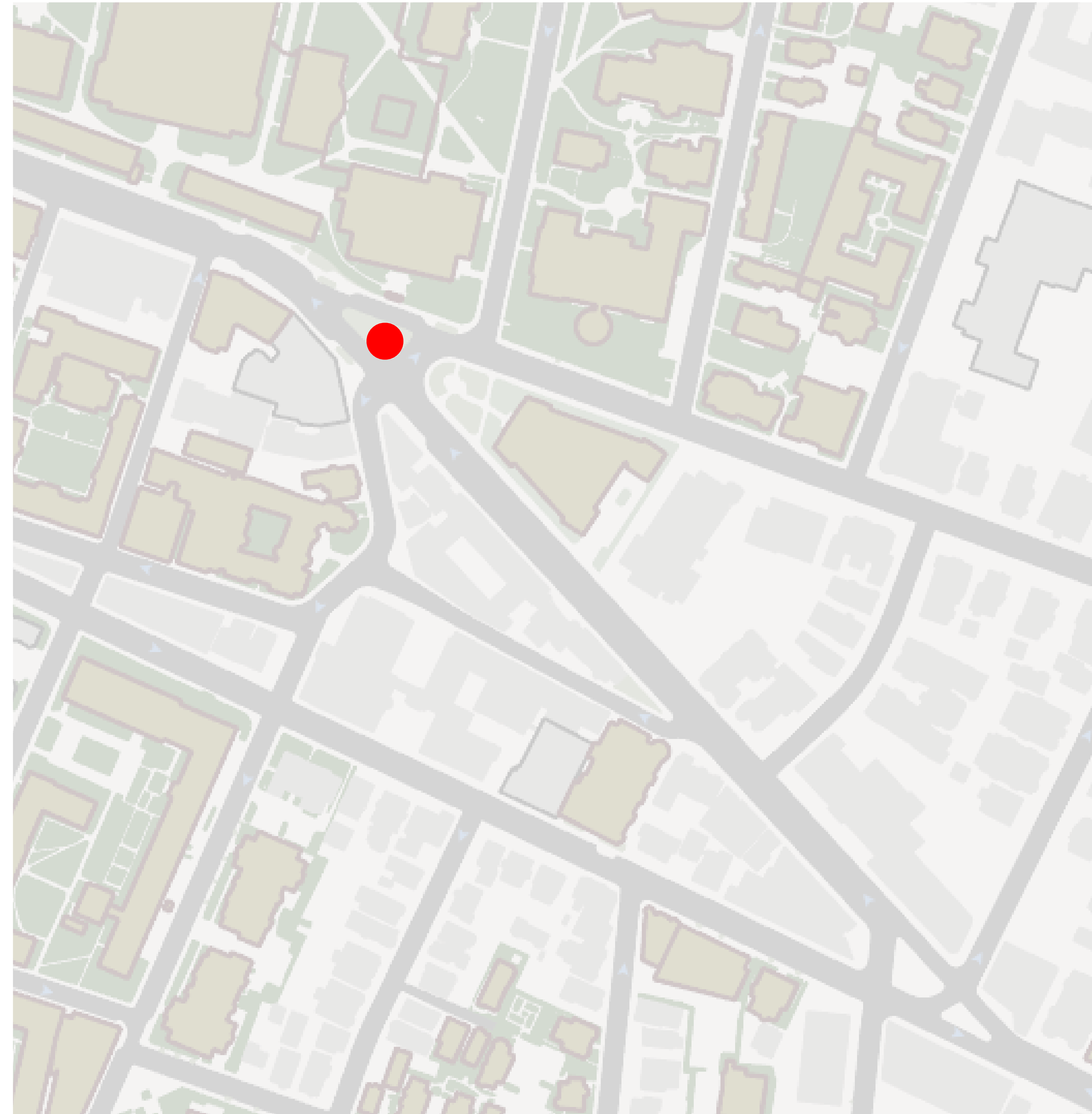




SITE

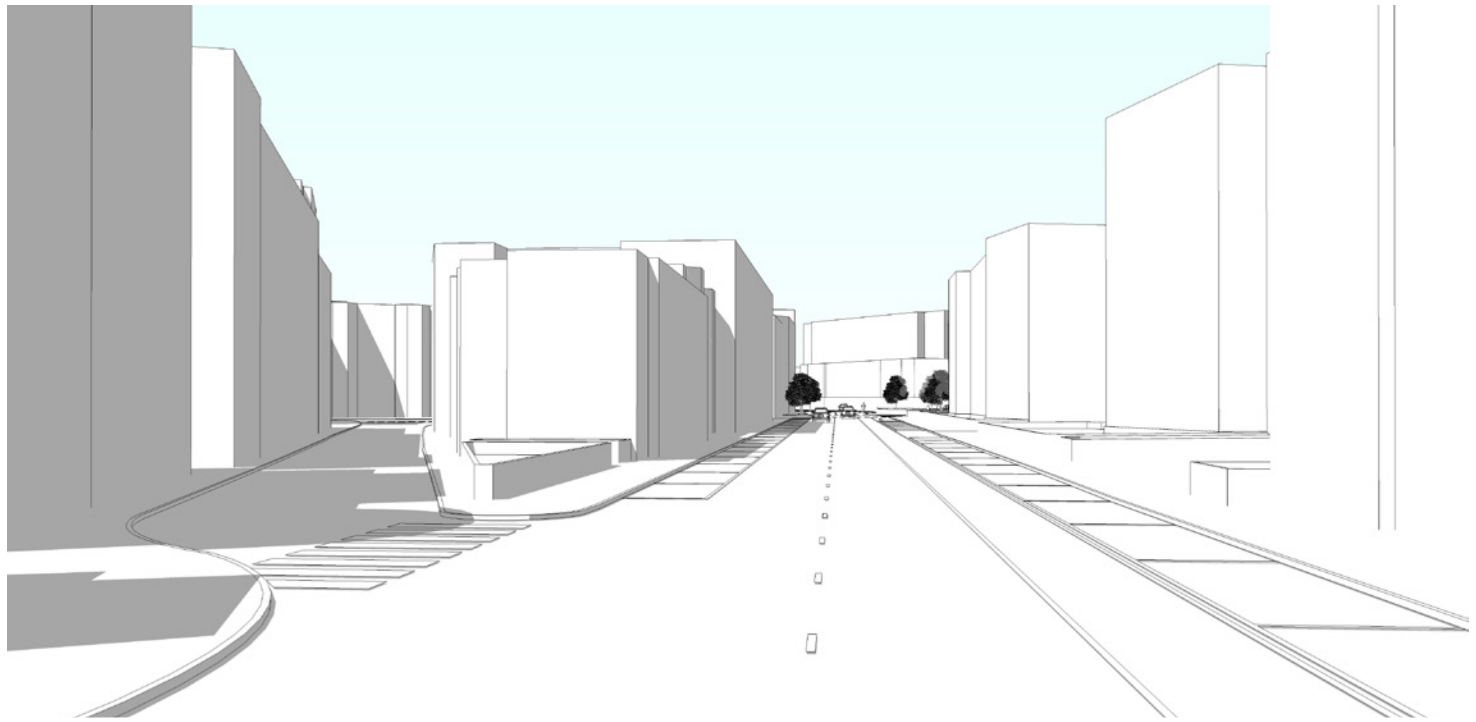
existing problems

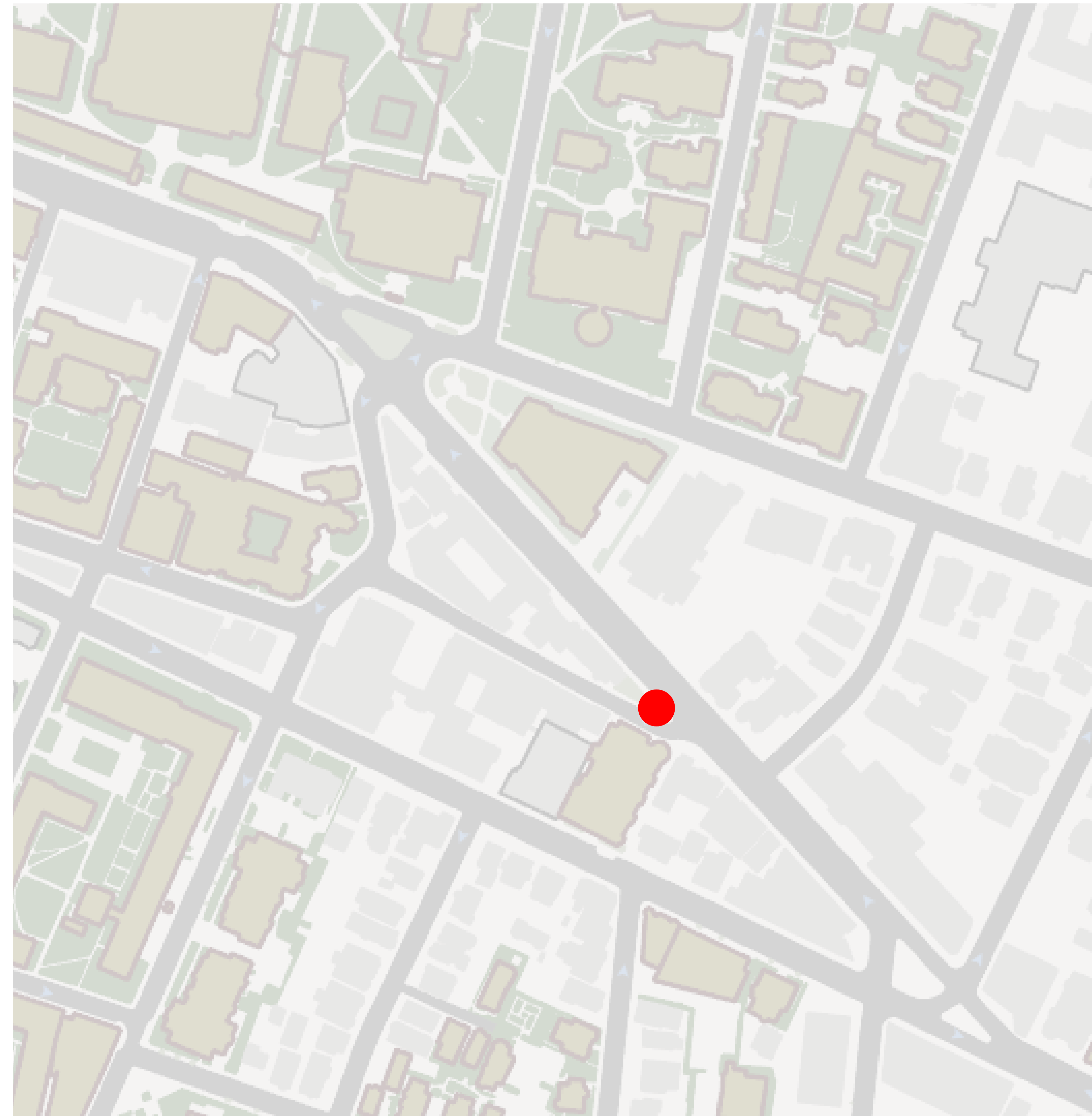




INTERSECTION 1

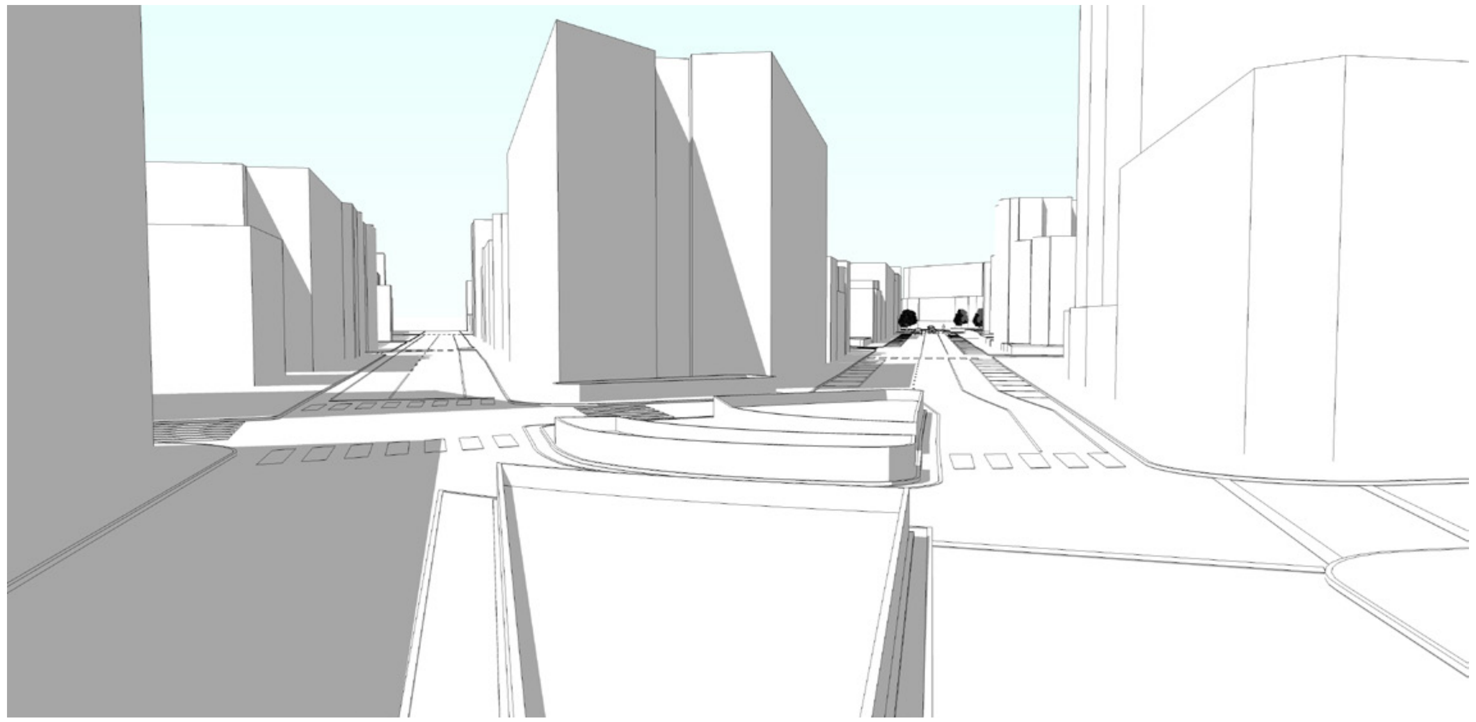
existing problems

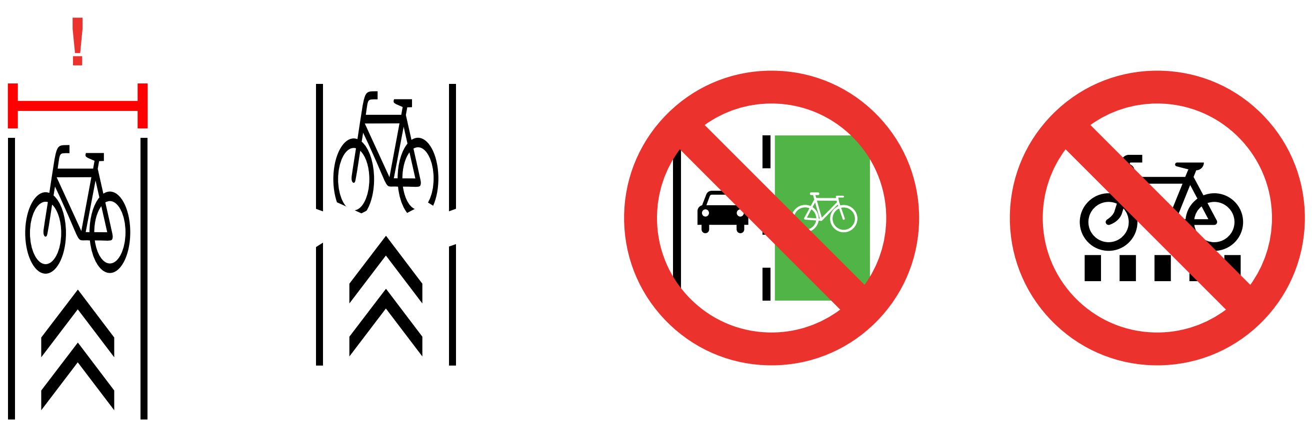


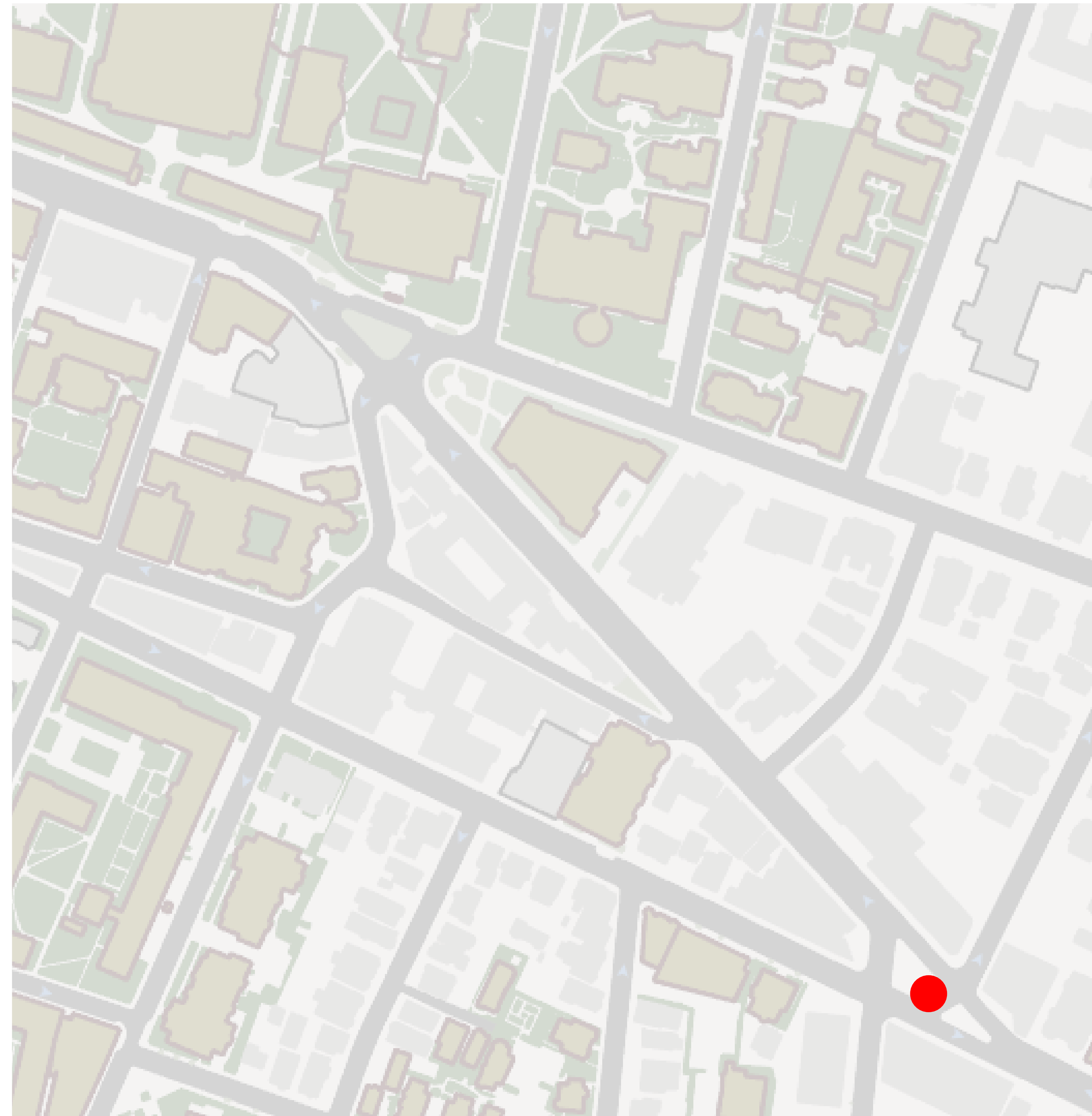


INTERSECTION 2

existing problems

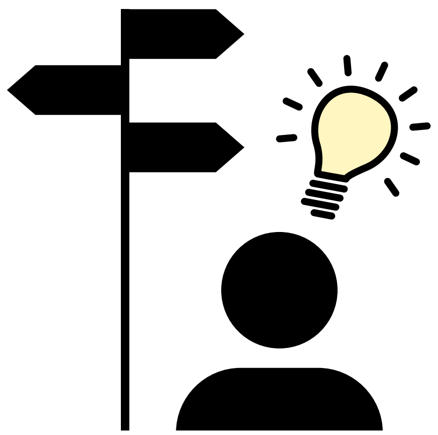




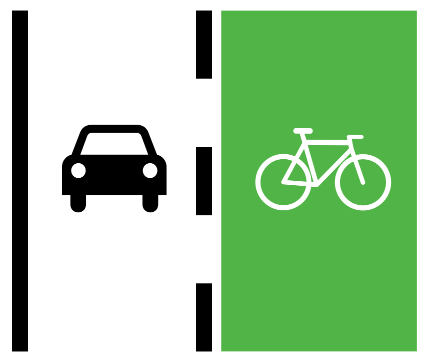


INTERSECTION 3

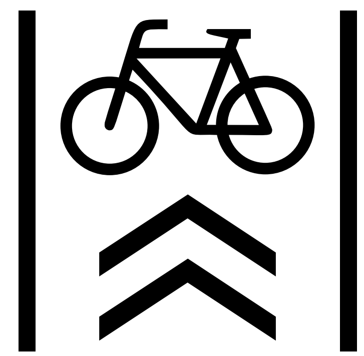
existing problems



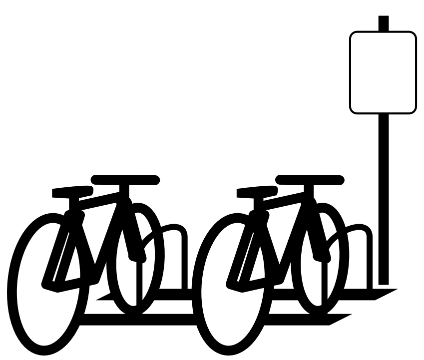
Clearer Signage



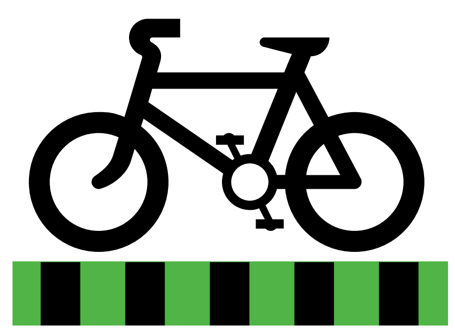
Protected Bike Lane



Wider Bike Lane



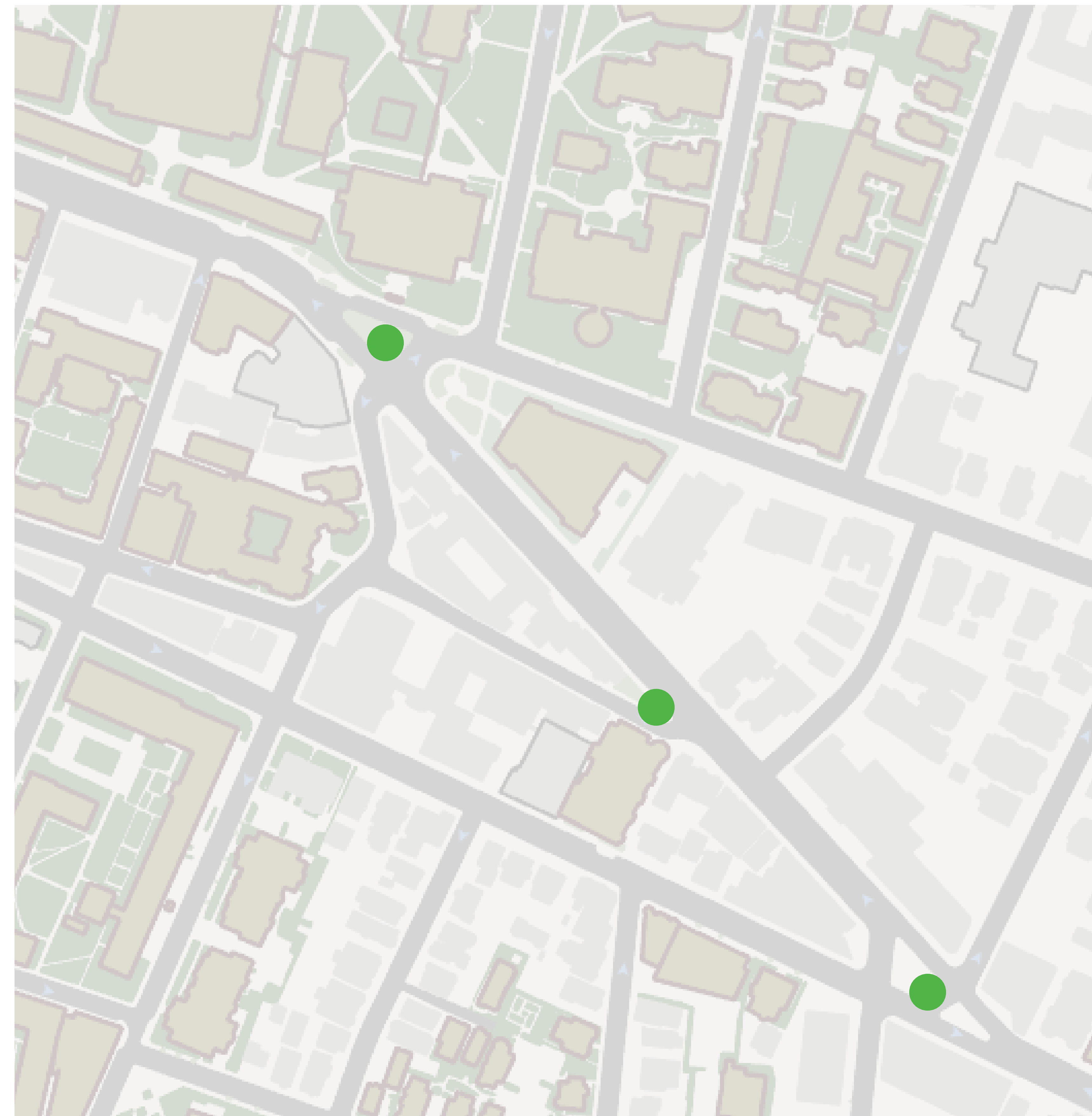
Bike Racks

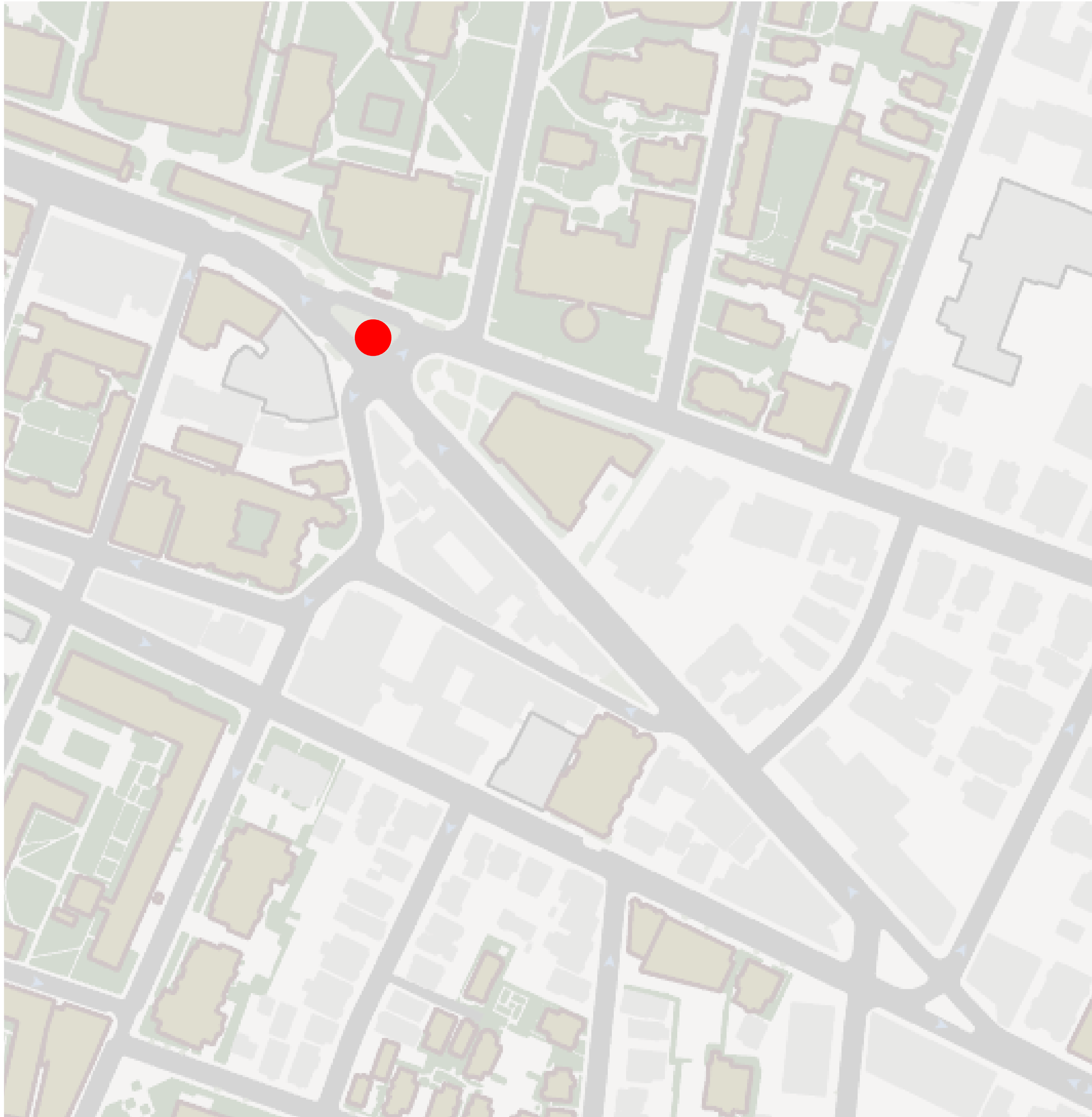


Bicycle Crossings with Road Bumps and Textured Materials

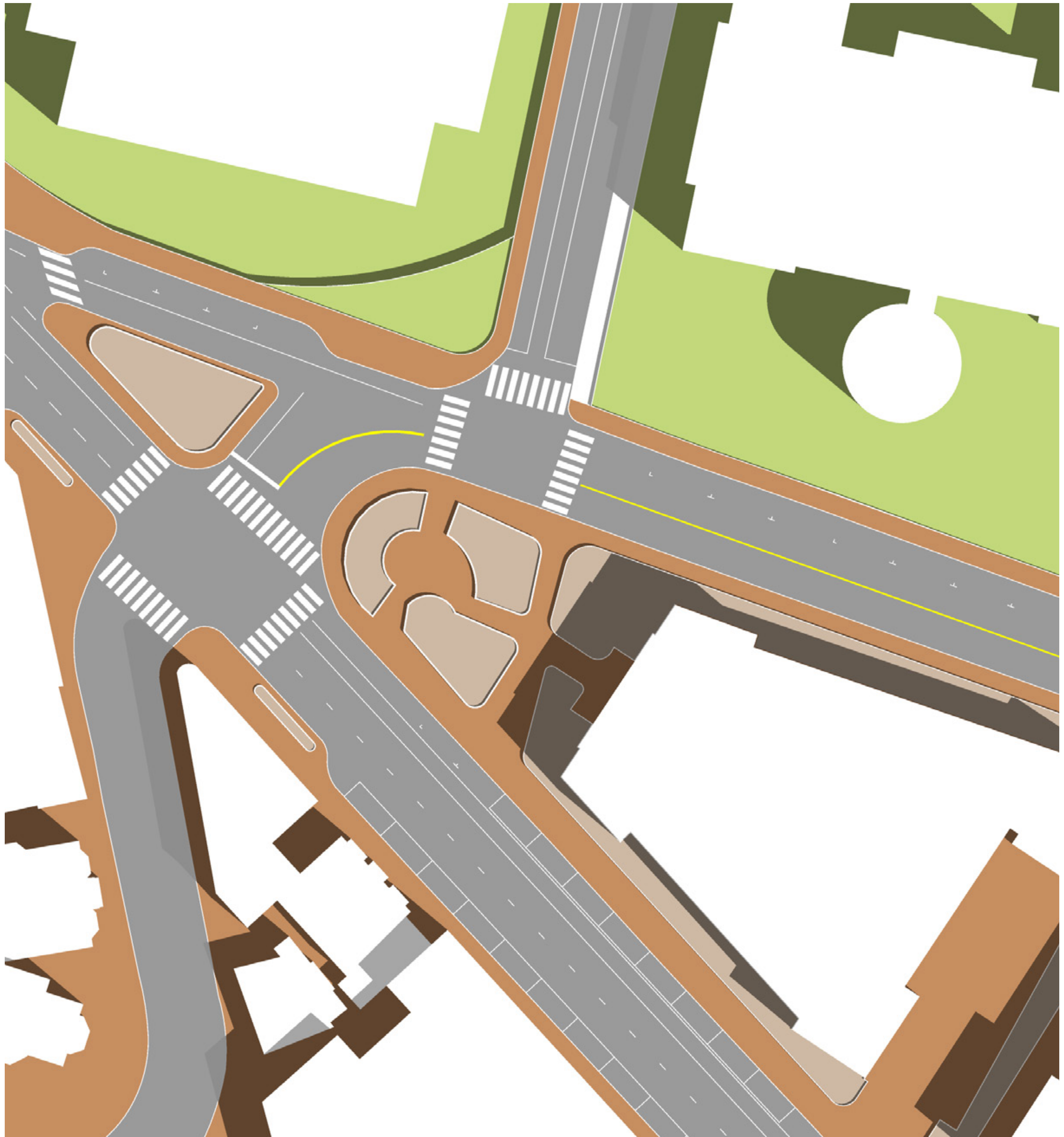
Continuous Bike Lane

DESIGN STRATEGIES

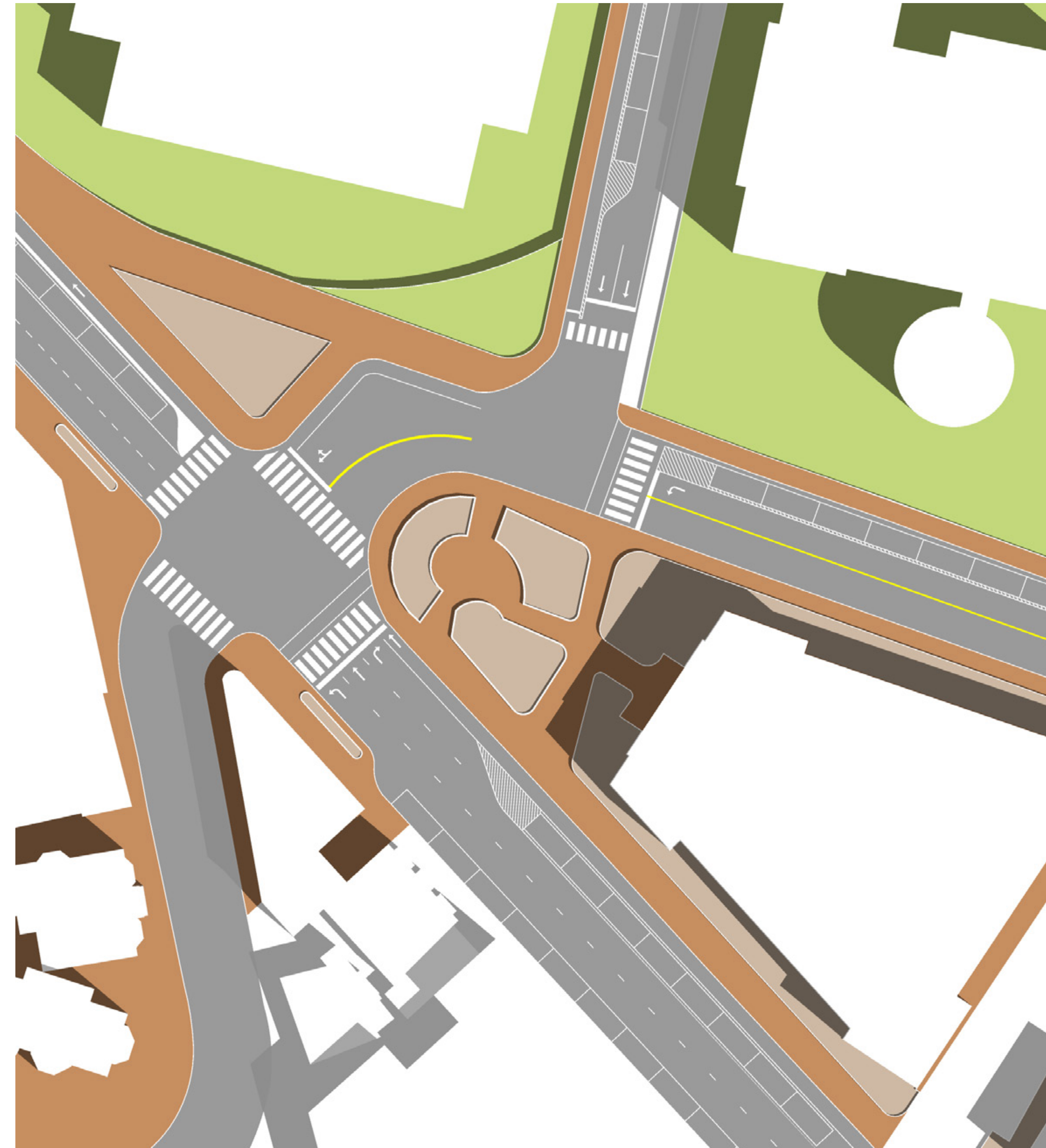




INTERSECTION 1

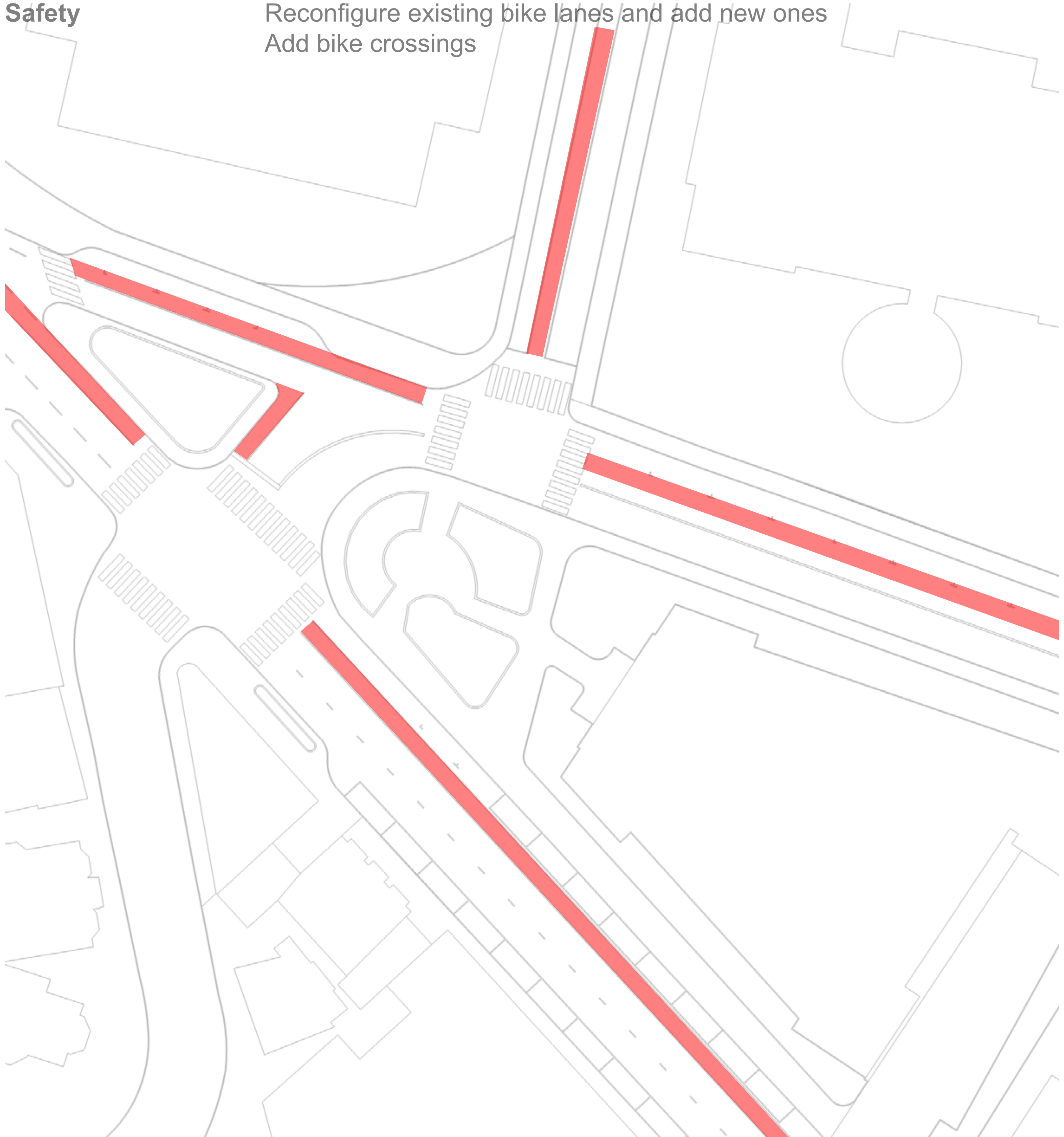


Existing Conditions

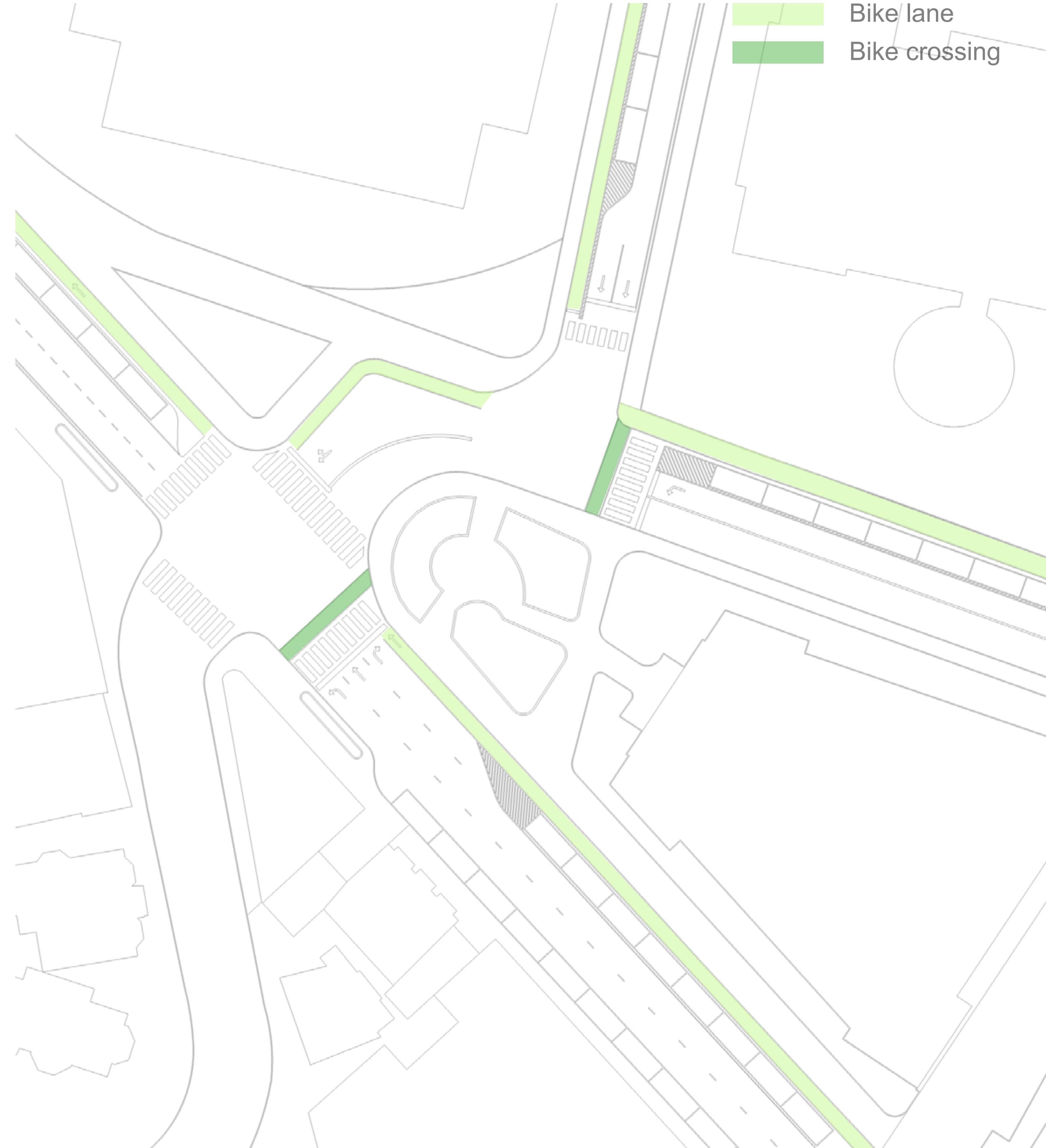


Interim Intervention

Safety Reconfigure existing bike lanes and add new ones
Add bike crossings

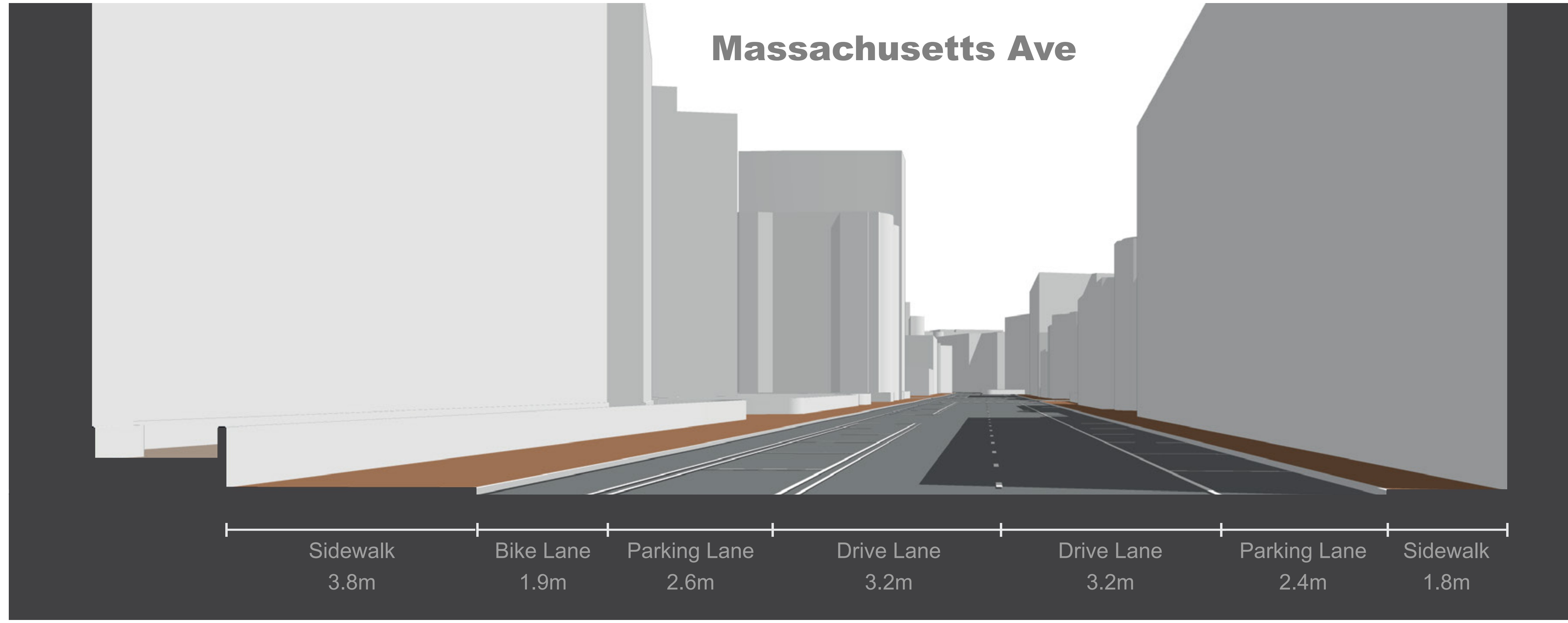


Existing Conditions

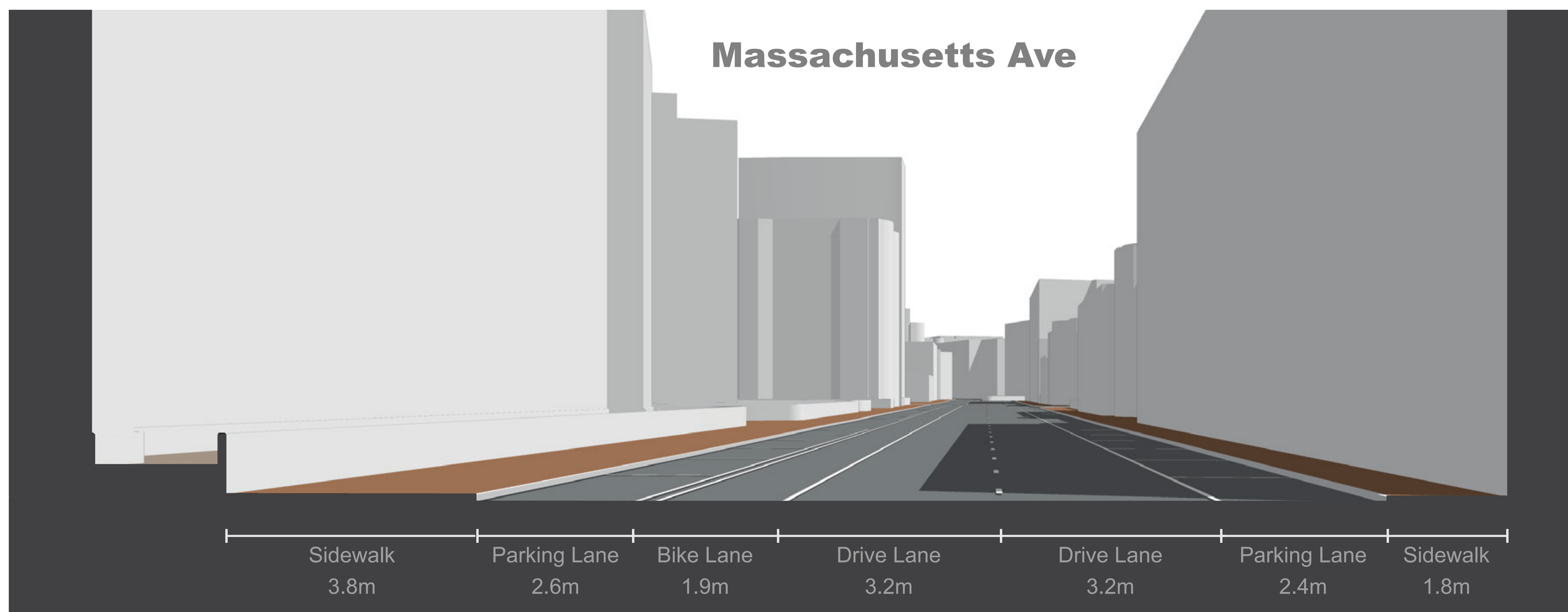


Interim Intervention

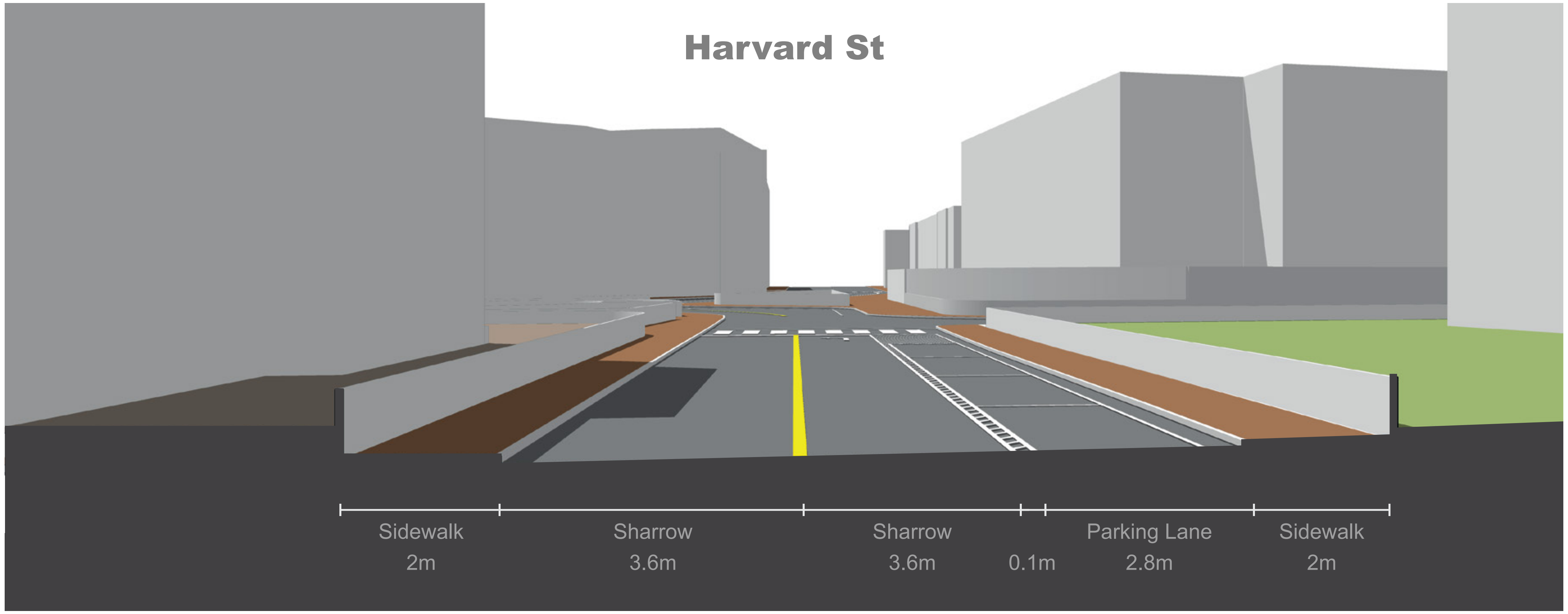
Interim Intervention



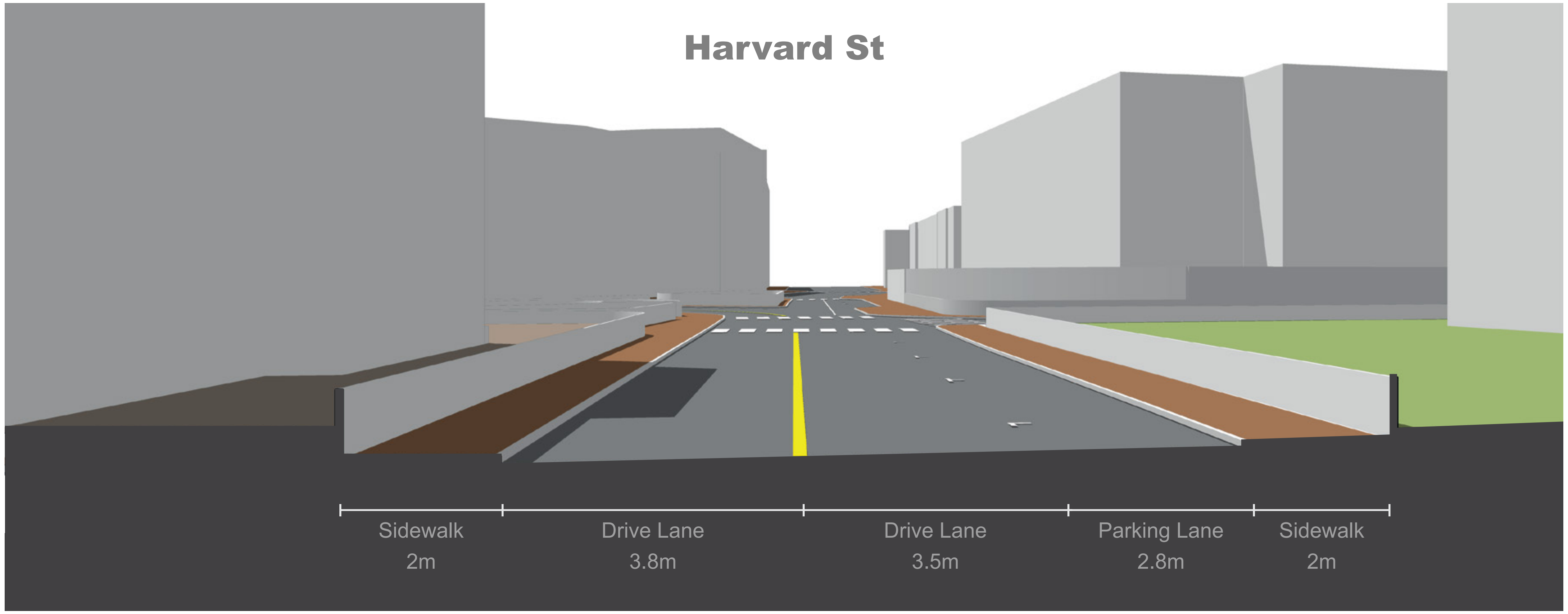
Existing Conditions



Interim Intervention



Existing Conditions

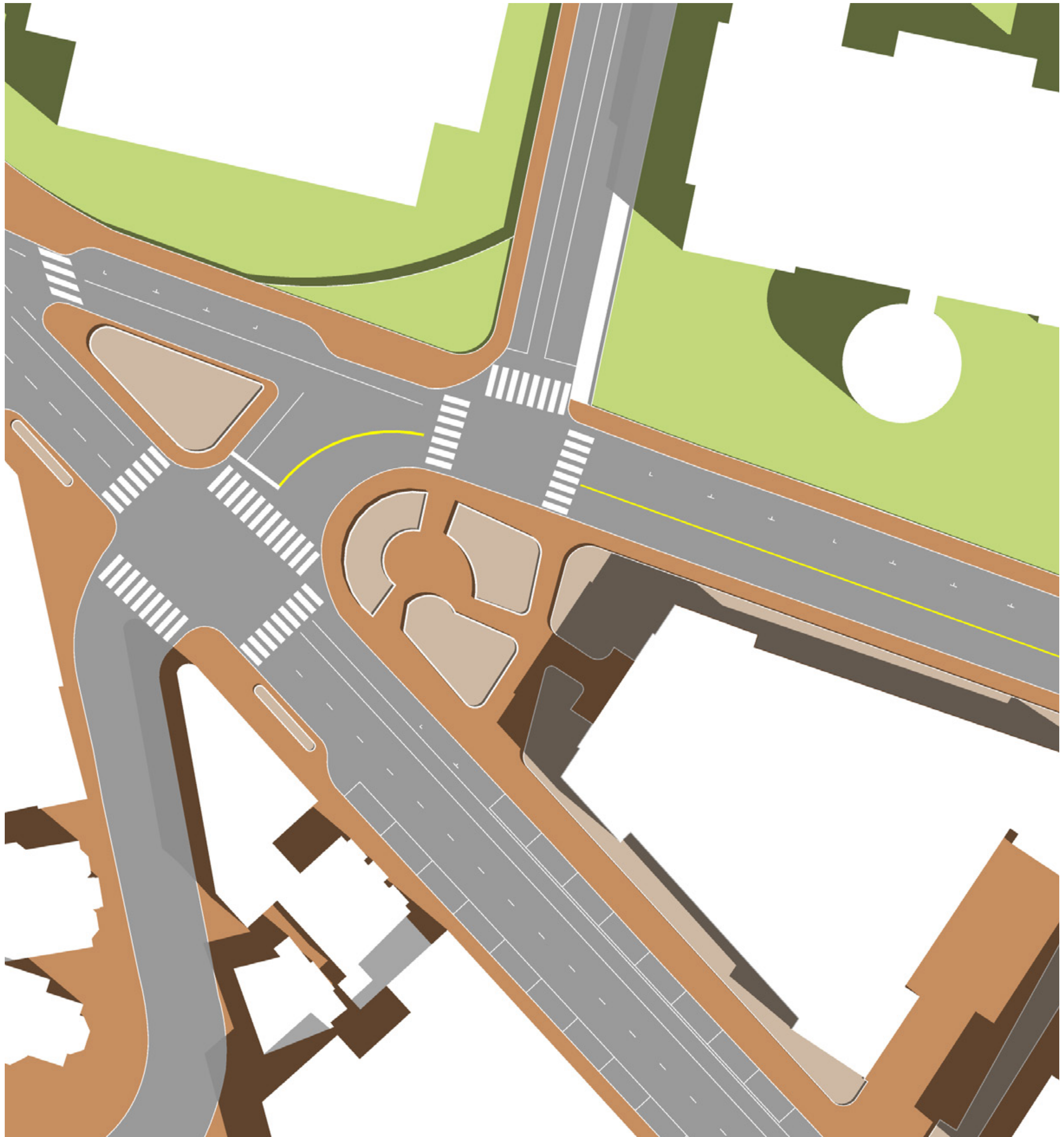


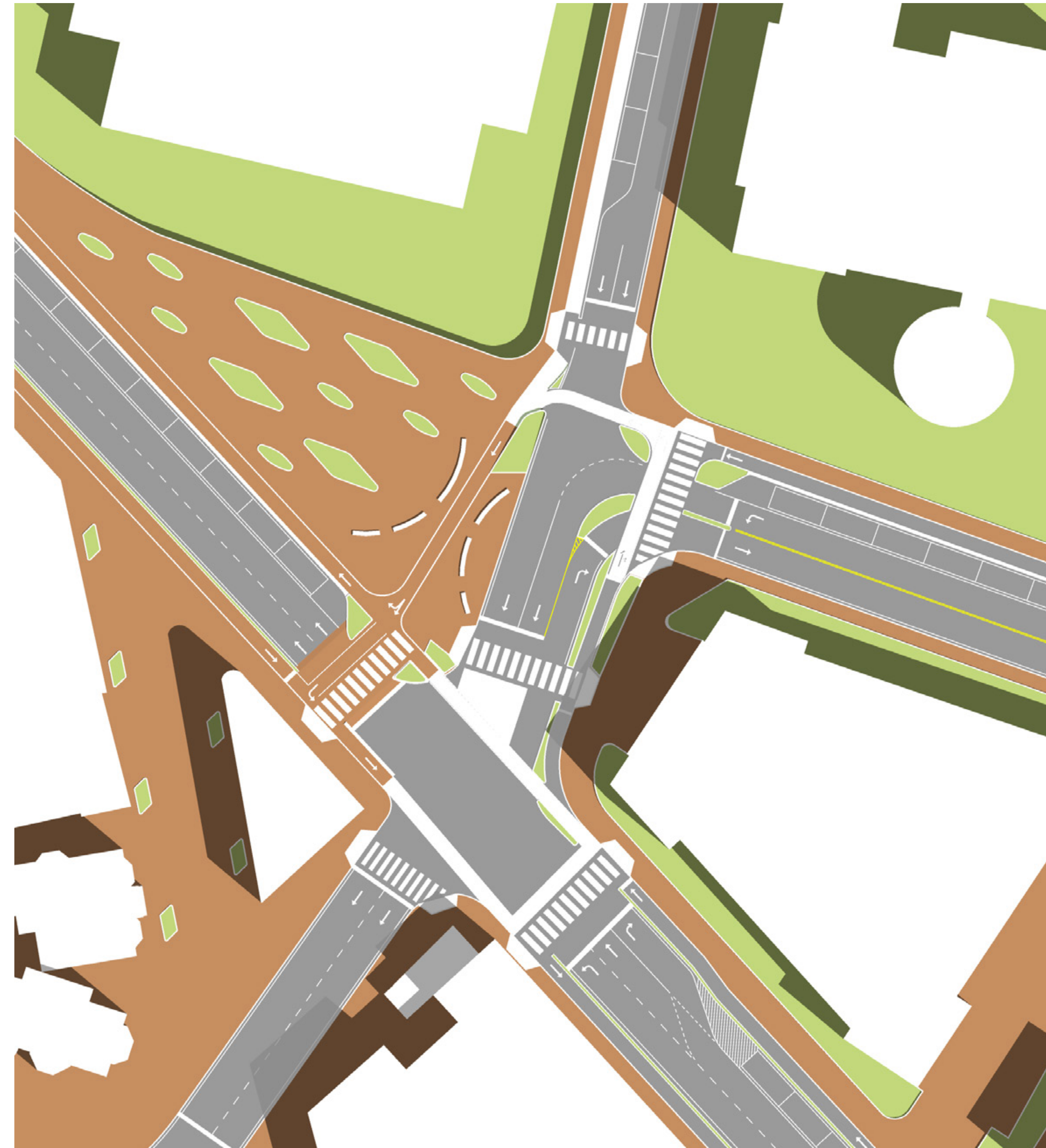
Interim Intervention

Existing Conditions

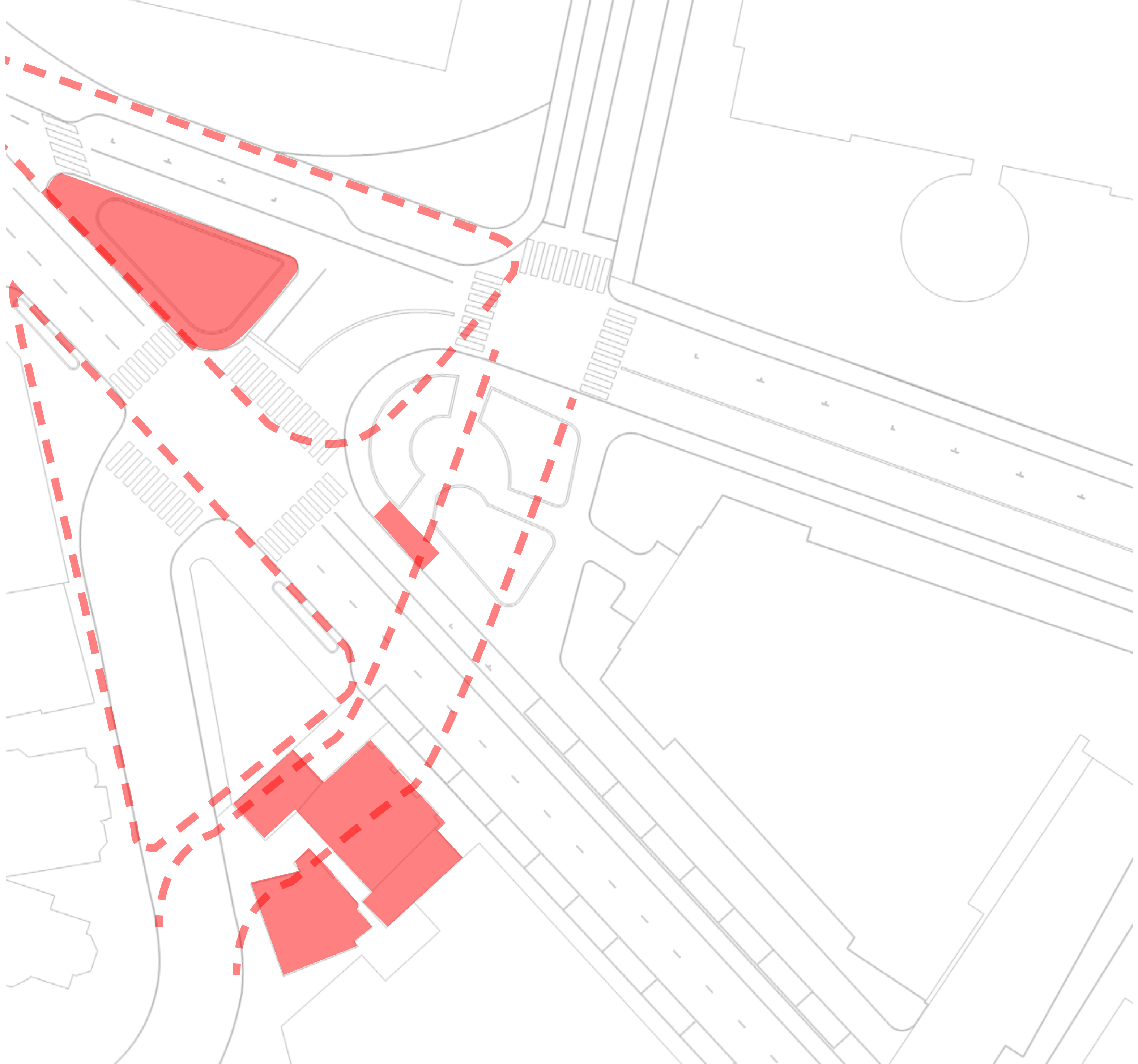
Interim Intervention

Existing Conditions


Existing Conditions


Final Design Proposal

Safety	Add protected bike lanes | Move bus stop to more convenient location
Placemaking	Redesign plaza to encourage greater public use
Thermal comfort	Increase vegetation and furniture for shading



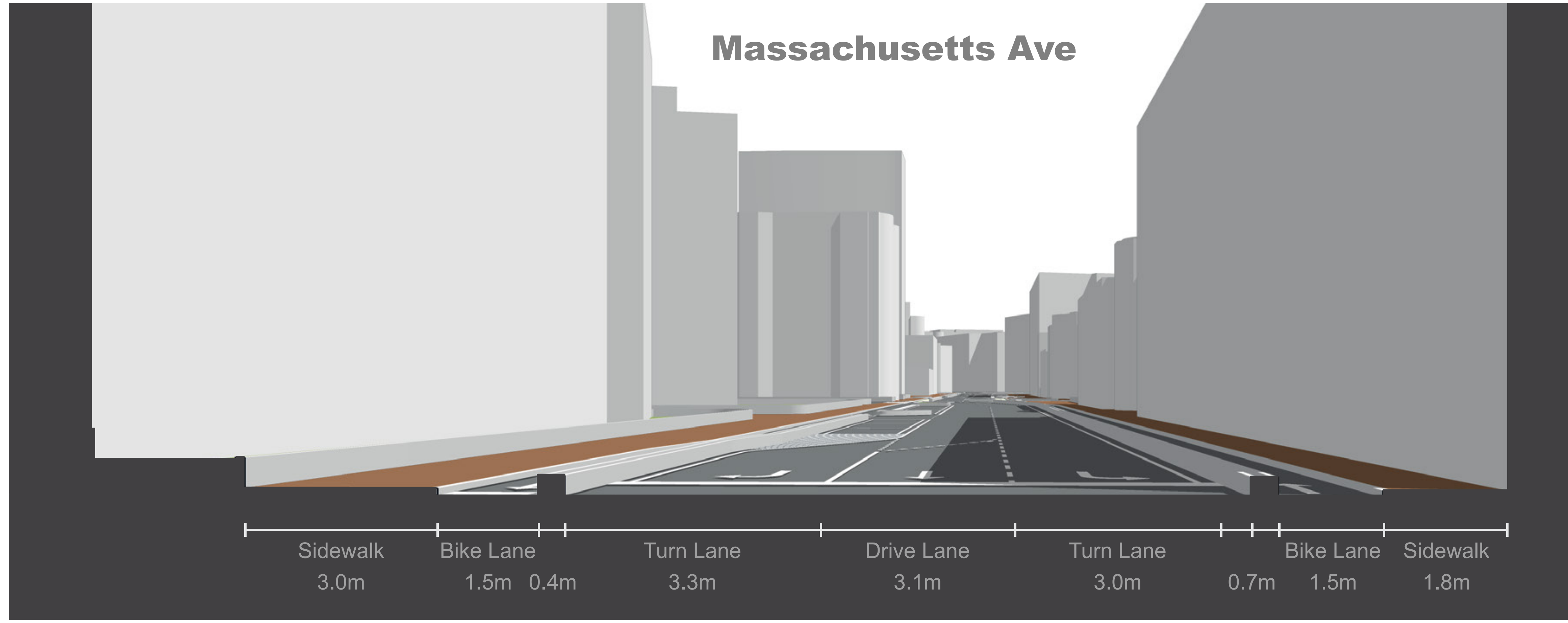
Existing Conditions

Final Design Proposal

CIRCULATION

final design proposal

Final Design Proposal



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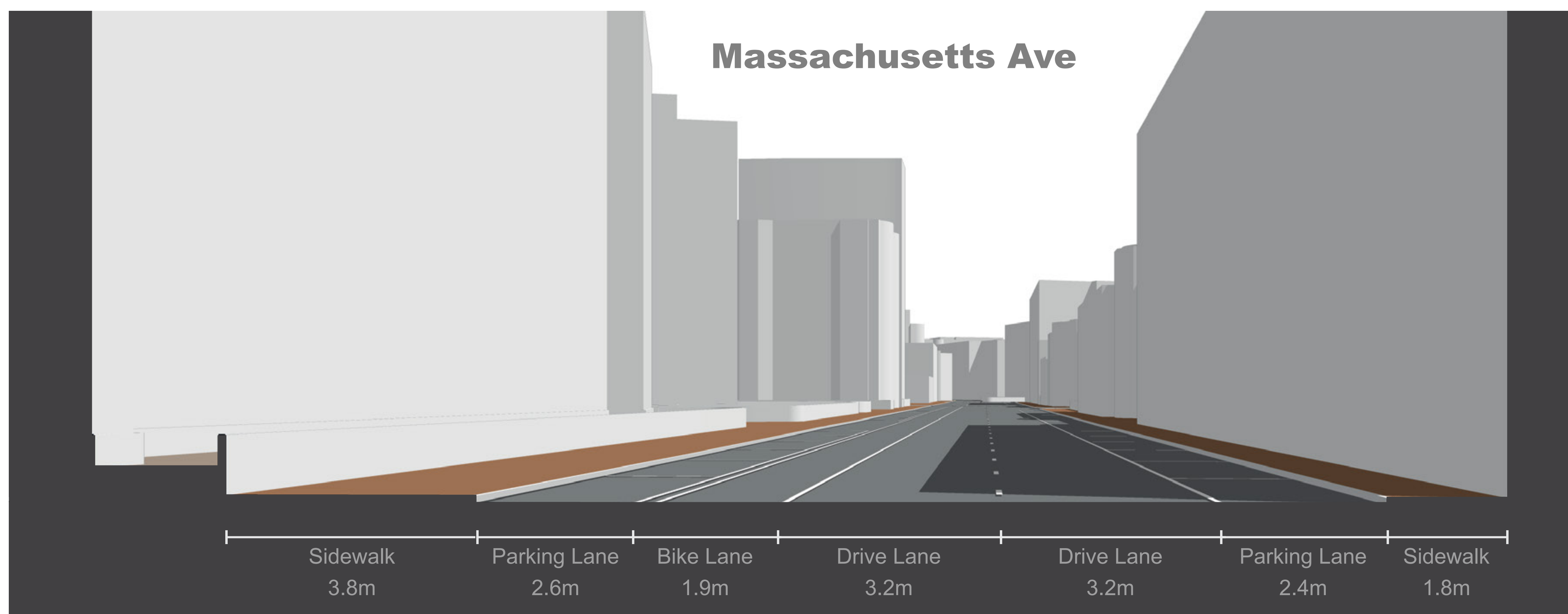

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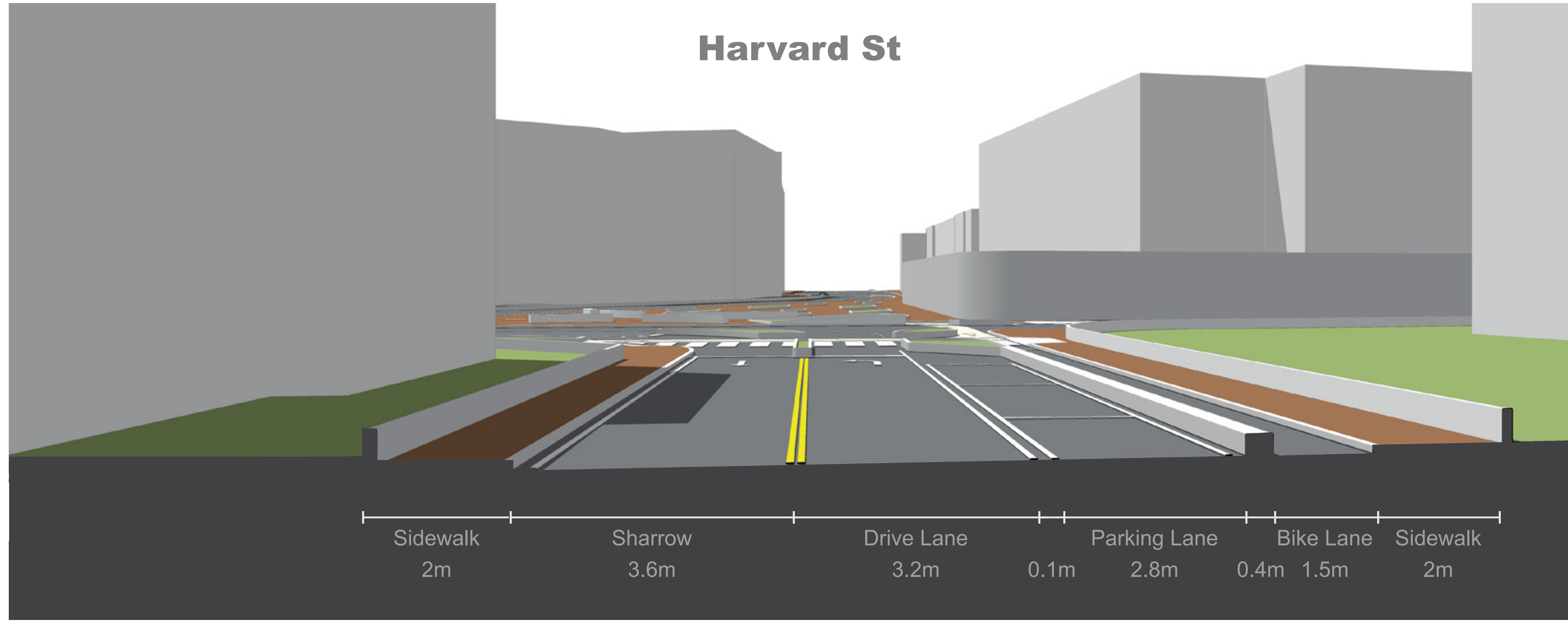

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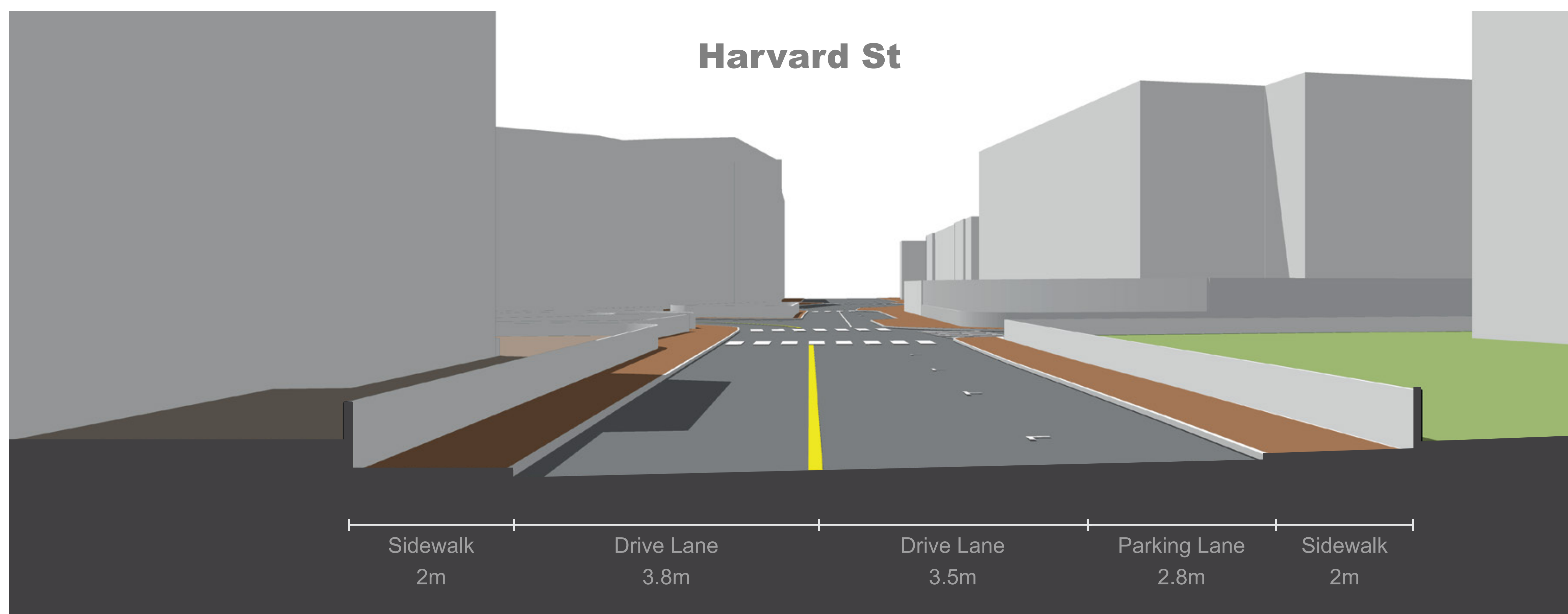

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Existing Conditions

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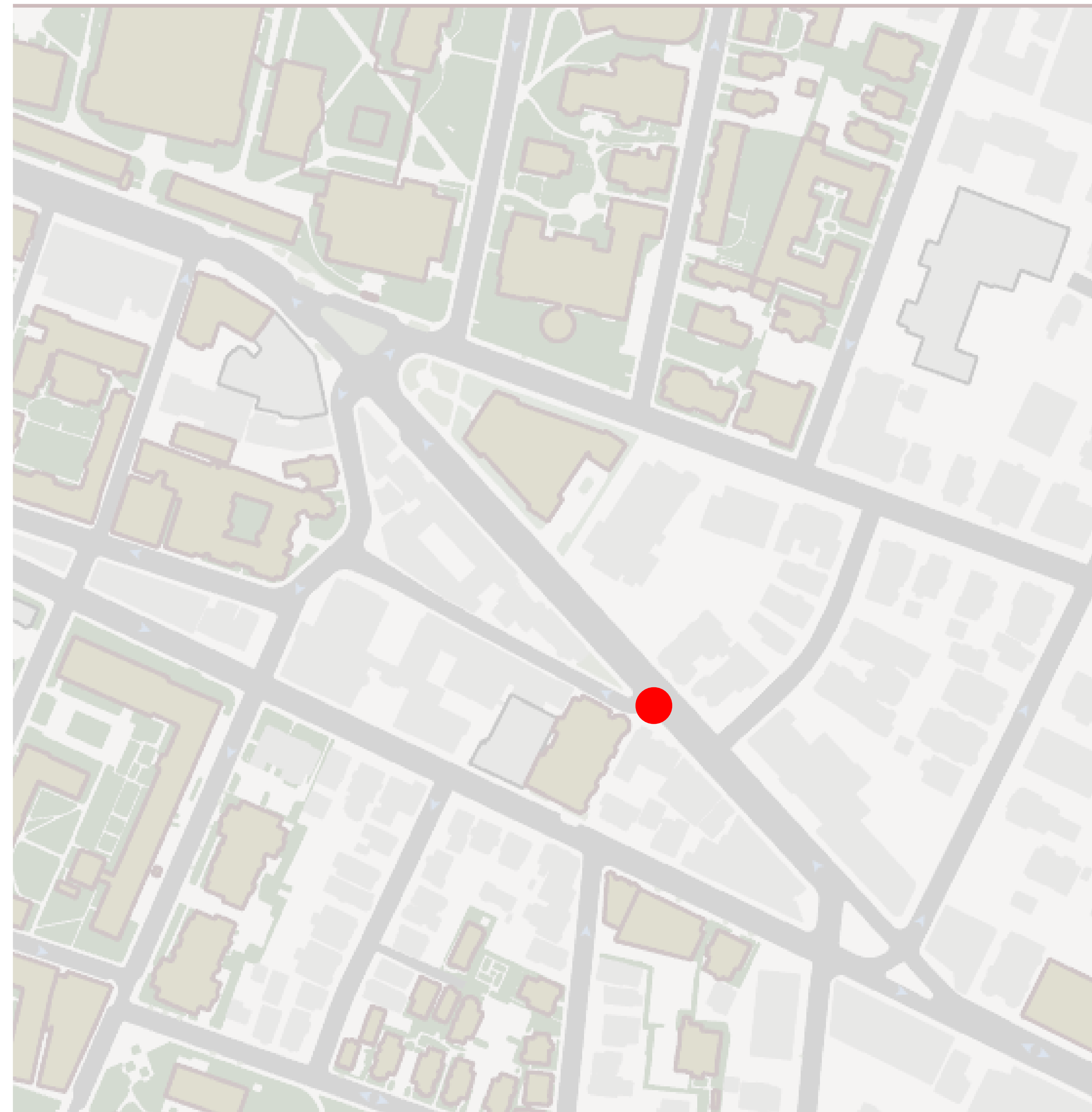
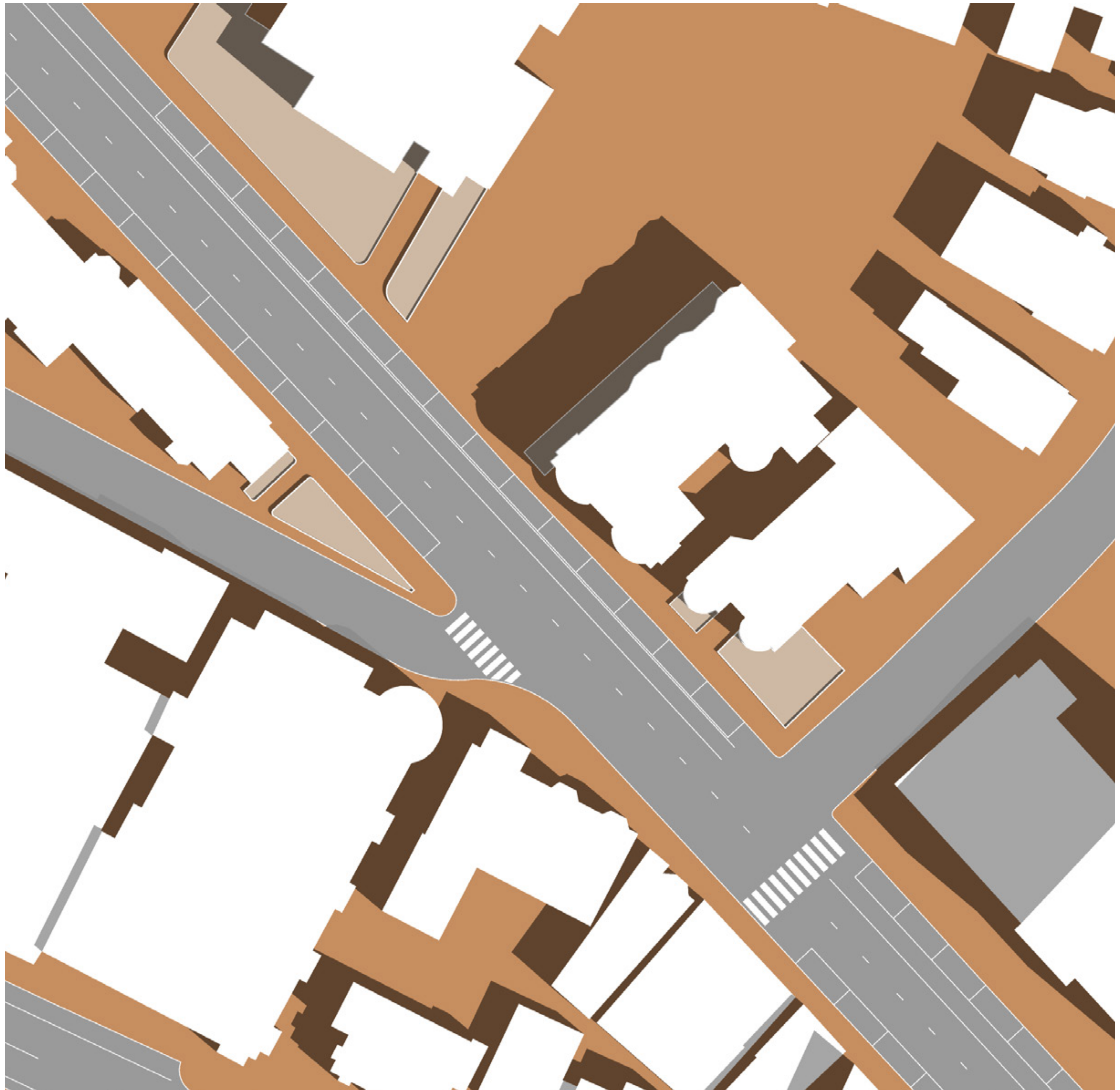


INTERSECTION 2

Interim Intervention

Existing Conditions



Existing Conditions

Final Design Proposal

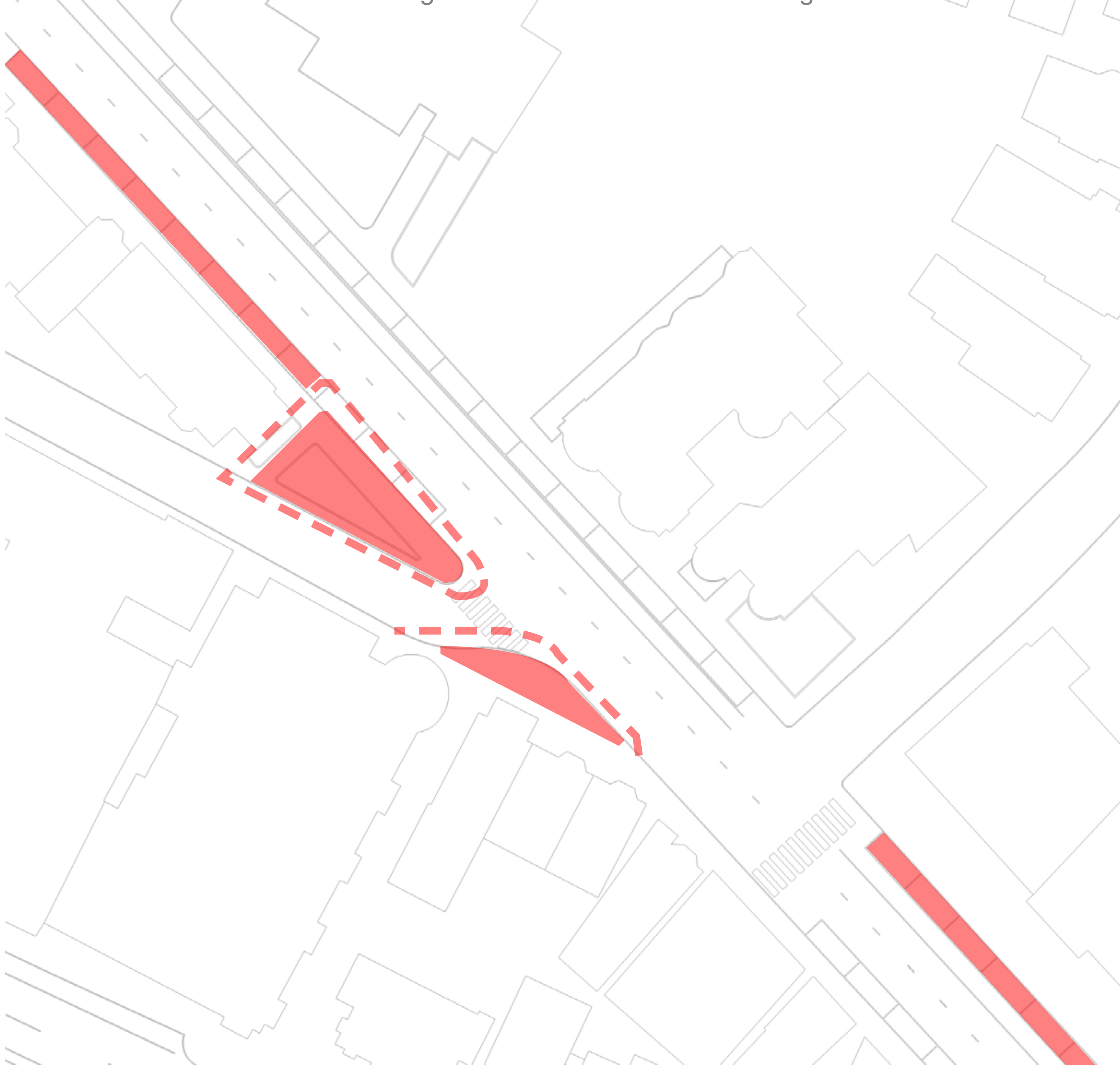
Safety Add protected bike lanes

Placemaking Redesign area to encourage greater public use

Thermal comfort Increase vegetation and furniture for shading

Protected bike lane

Enlarged pavement



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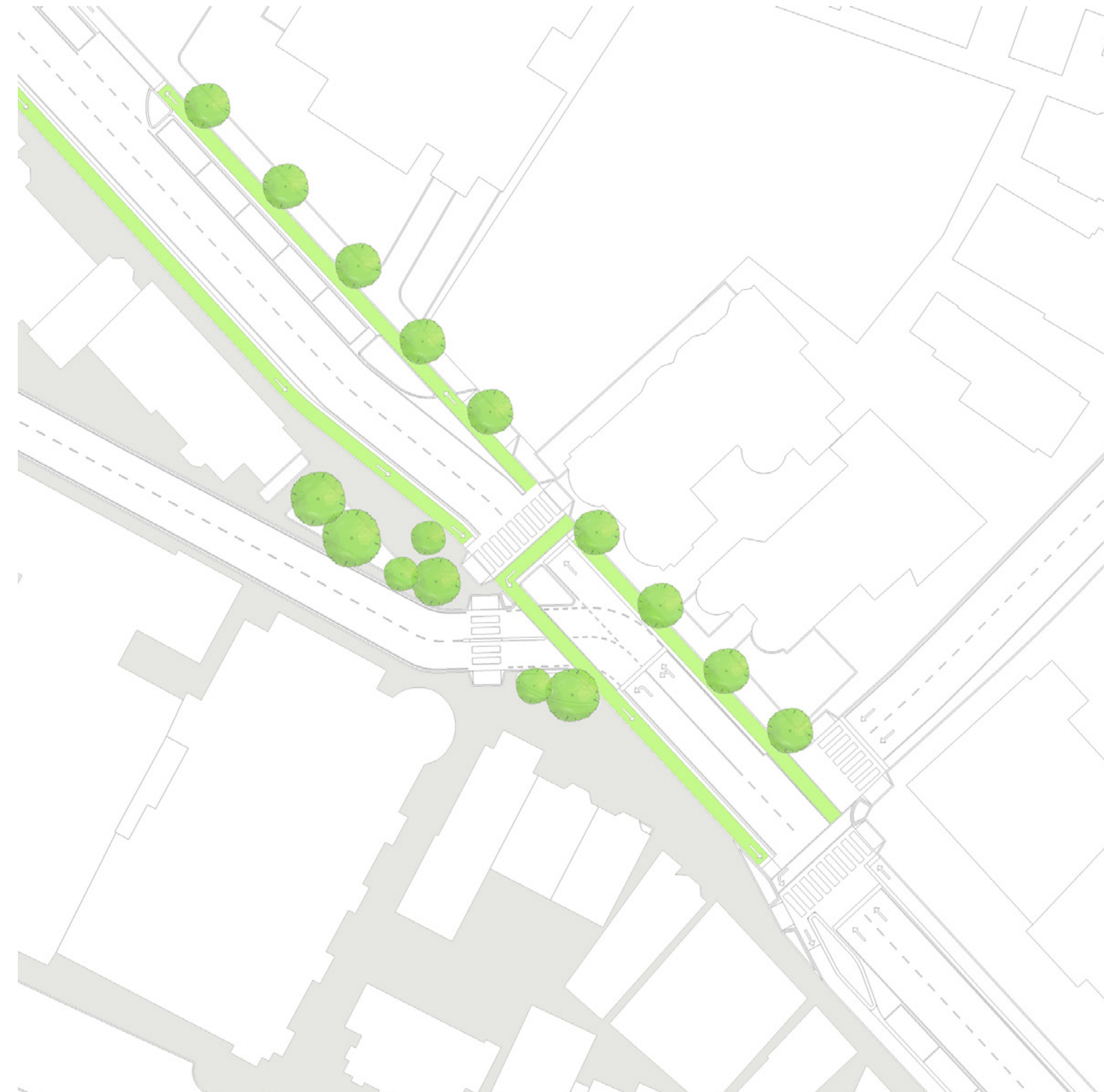

Final Design Proposal

Bike Circulation

Pedestrian Circulation

Car Circulation

CIRCULATION

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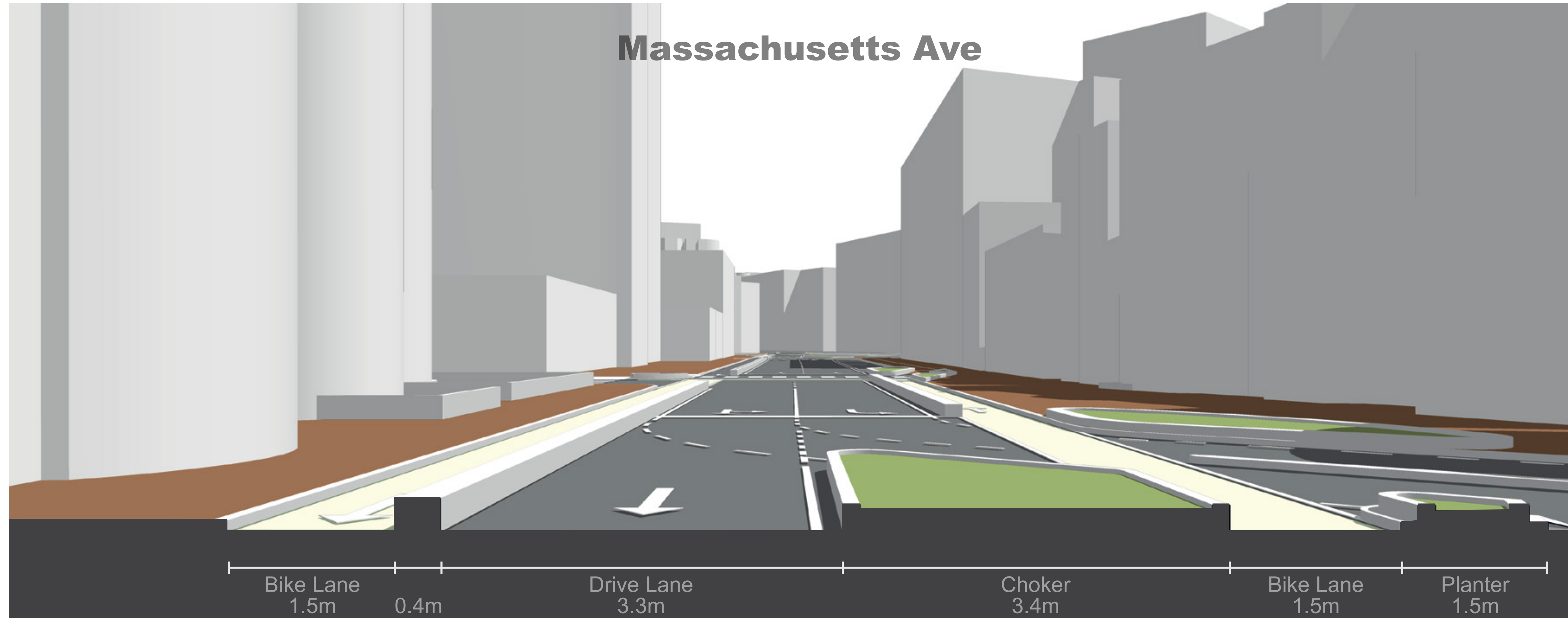
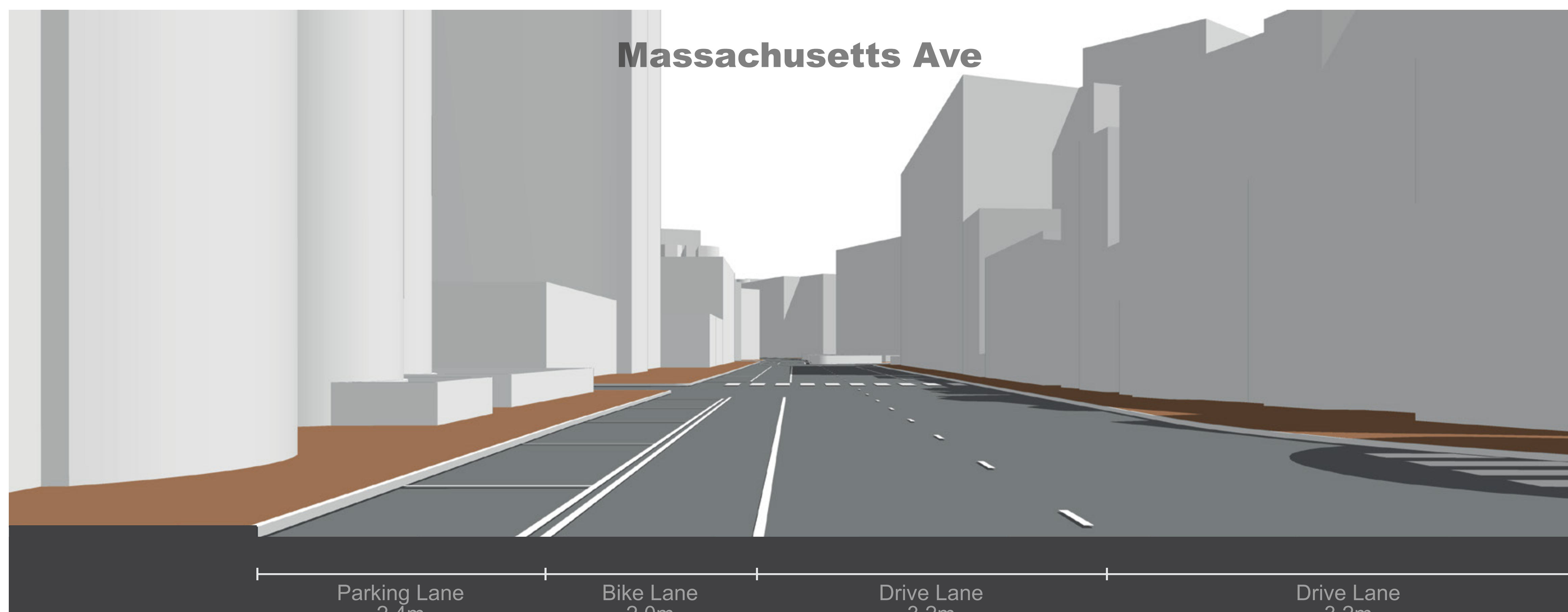
Final Design Proposal



Existing Conditions



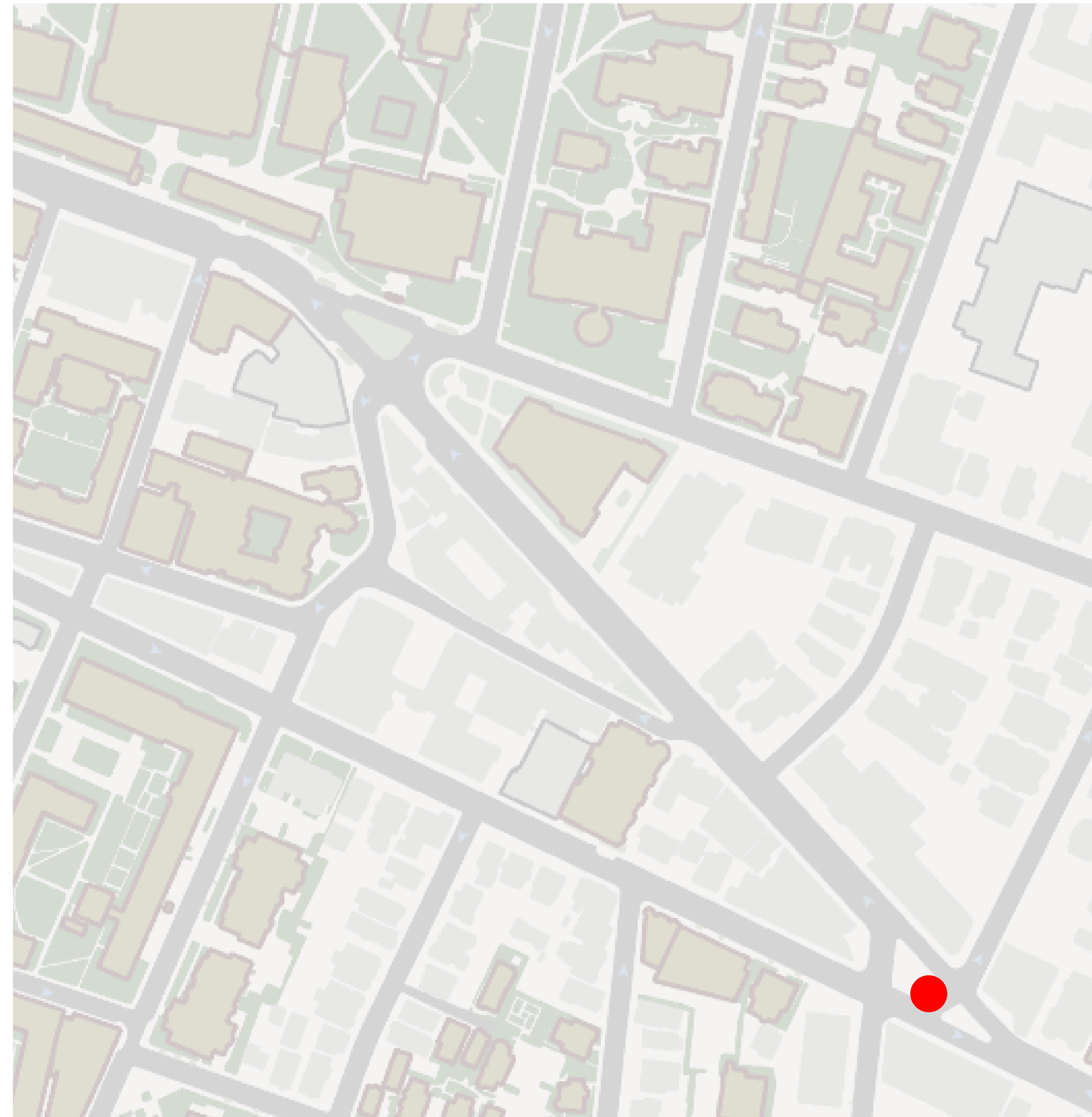
Final Design Proposal

Existing Conditions

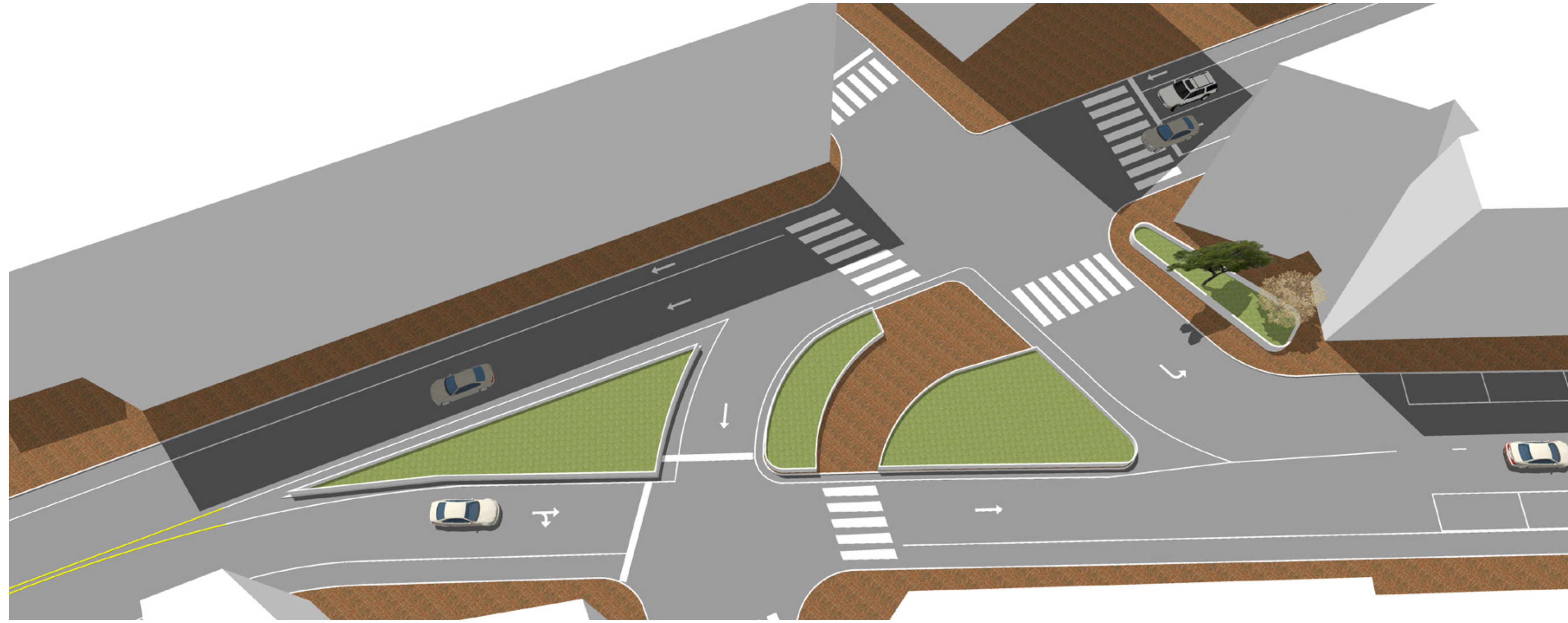
Final Design Proposal

Existing Conditions

INTERSECTION 3



Interim Intervention



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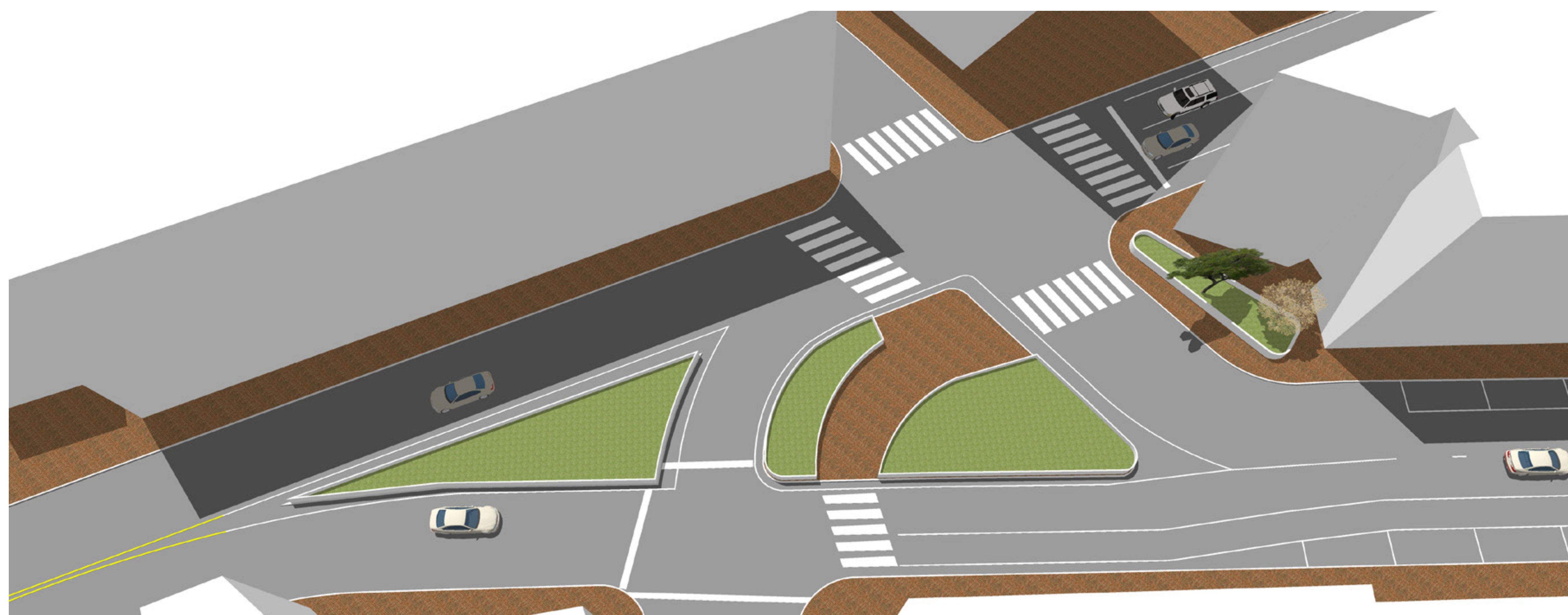
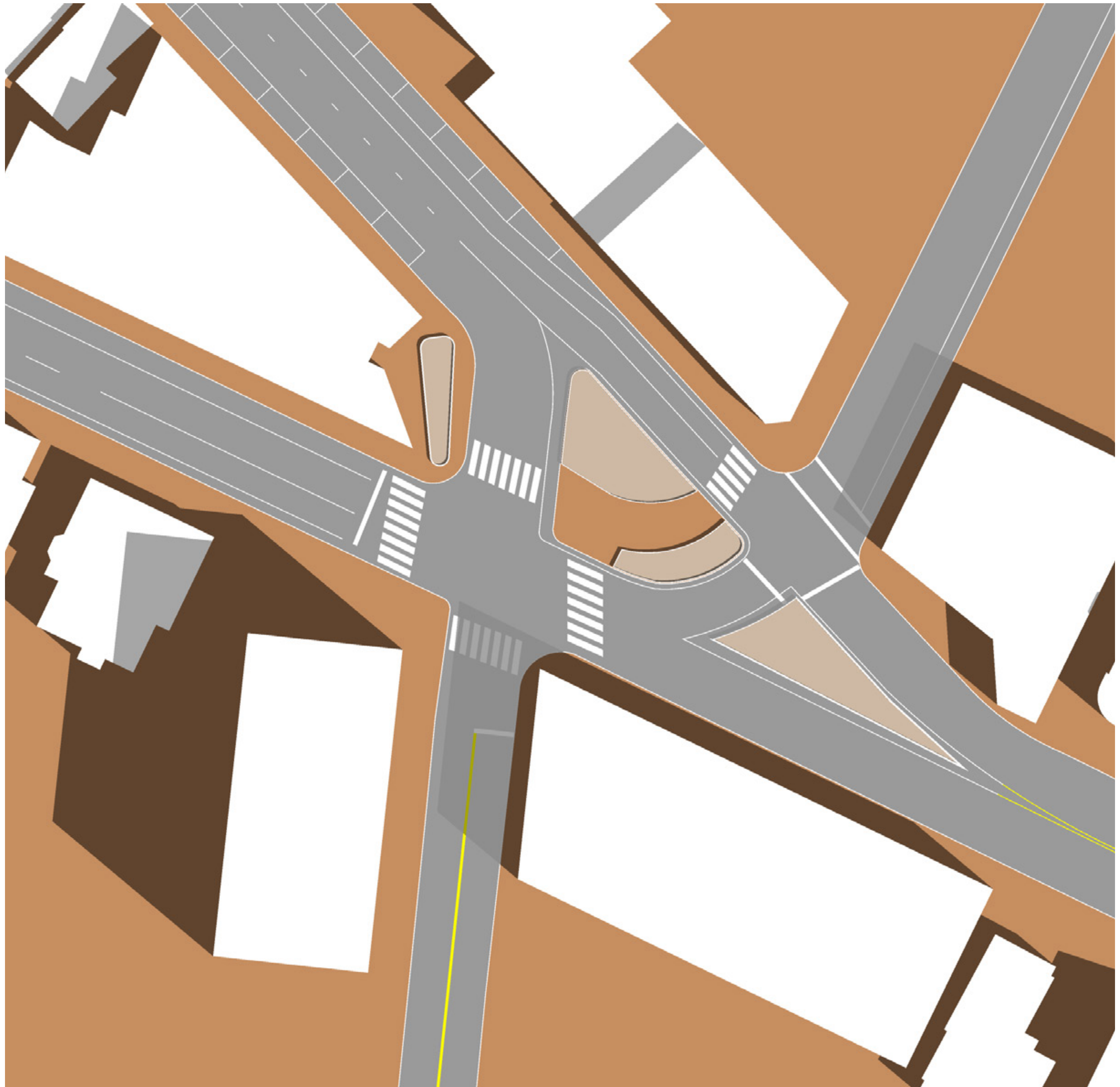
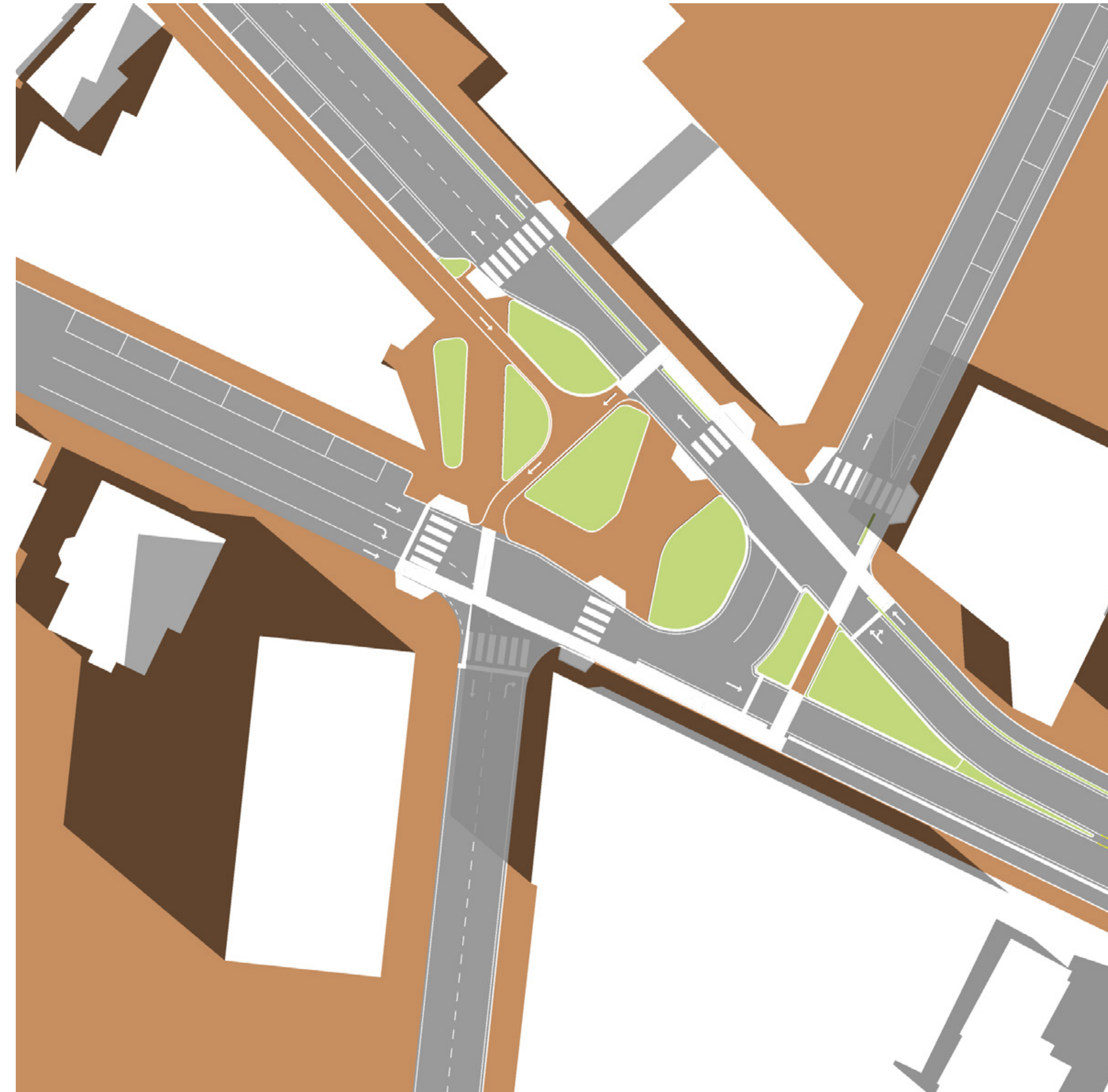



Existing Conditions


Final Design Proposal

Safety	Add protected bike lanes
Placemaking	Redesign area to encourage greater public use
Thermal comfort	Increase vegetation and furniture for shading

Protected bike lane

Enlarged pavement

Existing Conditions

Final Design Proposal

Bike Circulation

Pedestrian Circulation

Car Circulation

CIRCULATION

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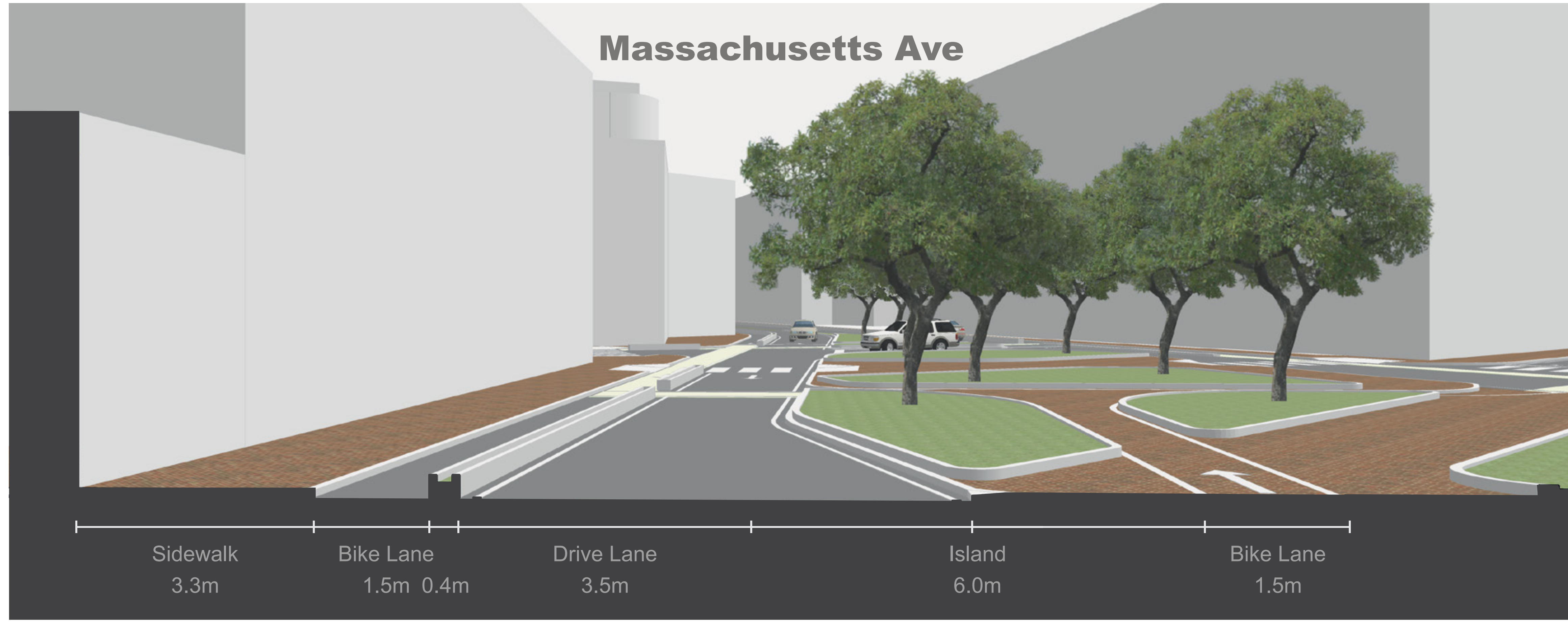
Final Design Proposal



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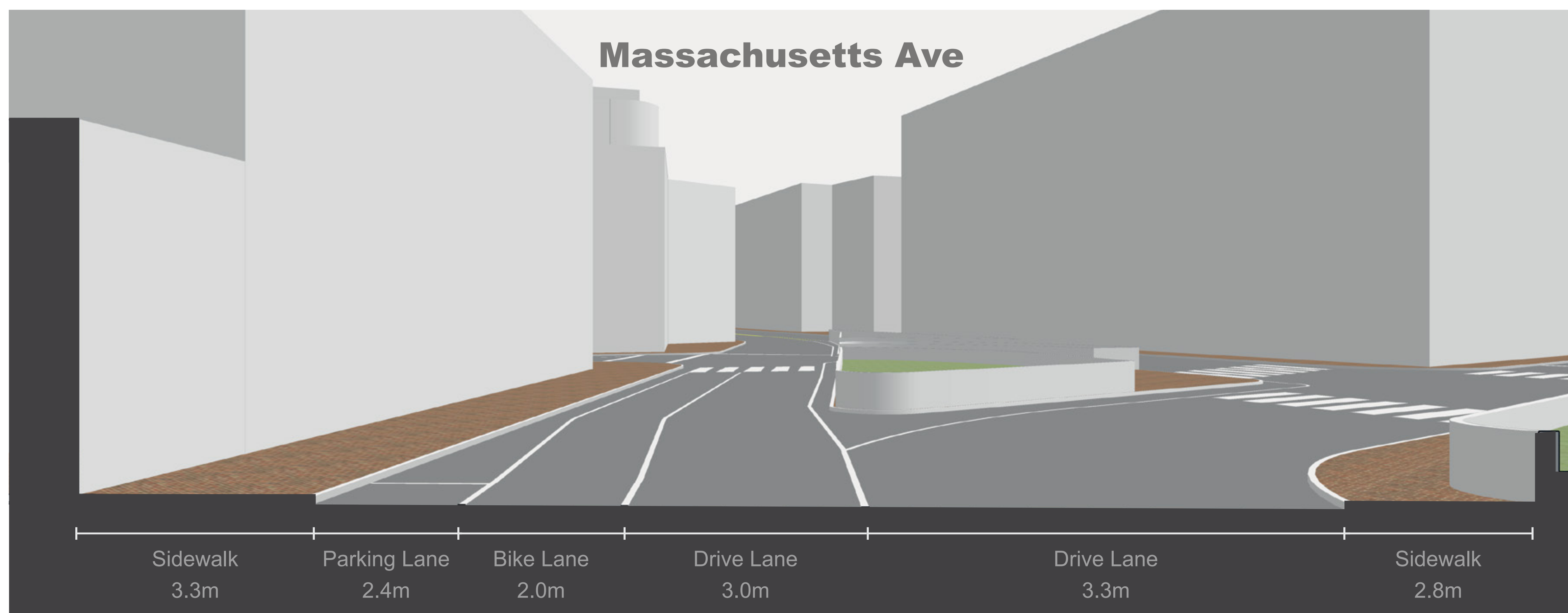
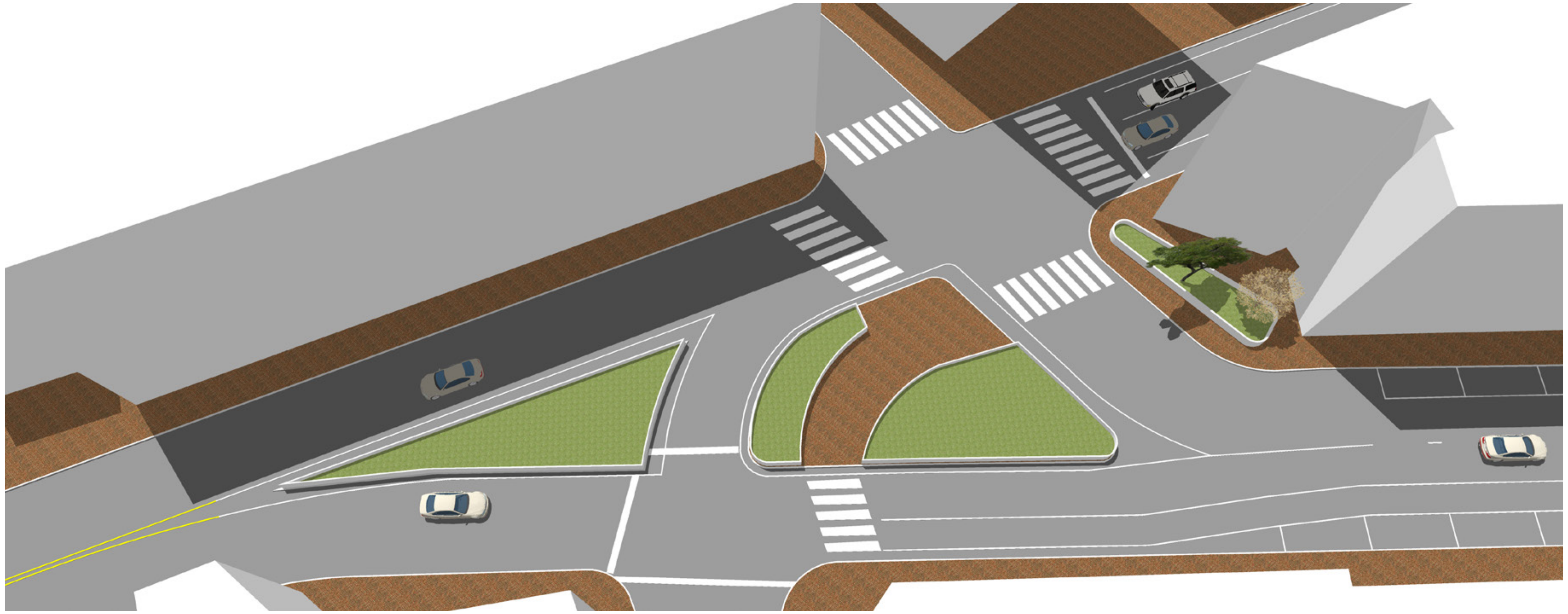


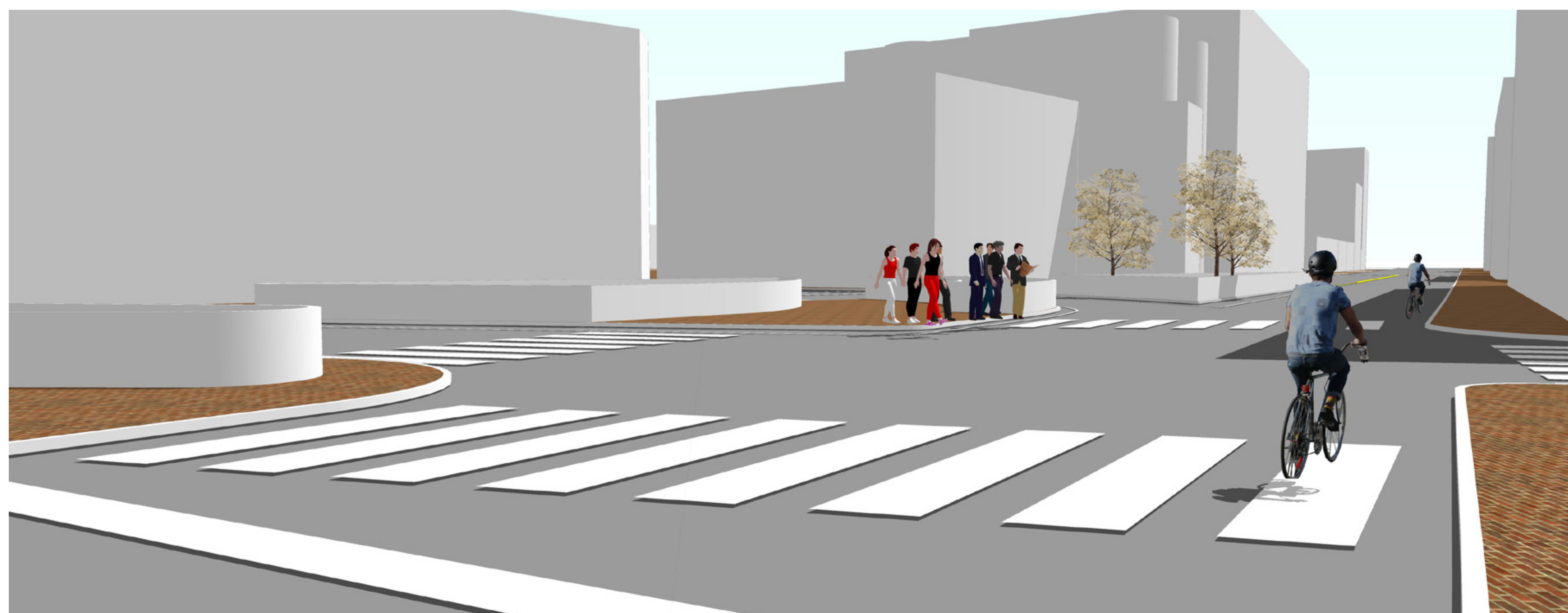
Final Design Proposal

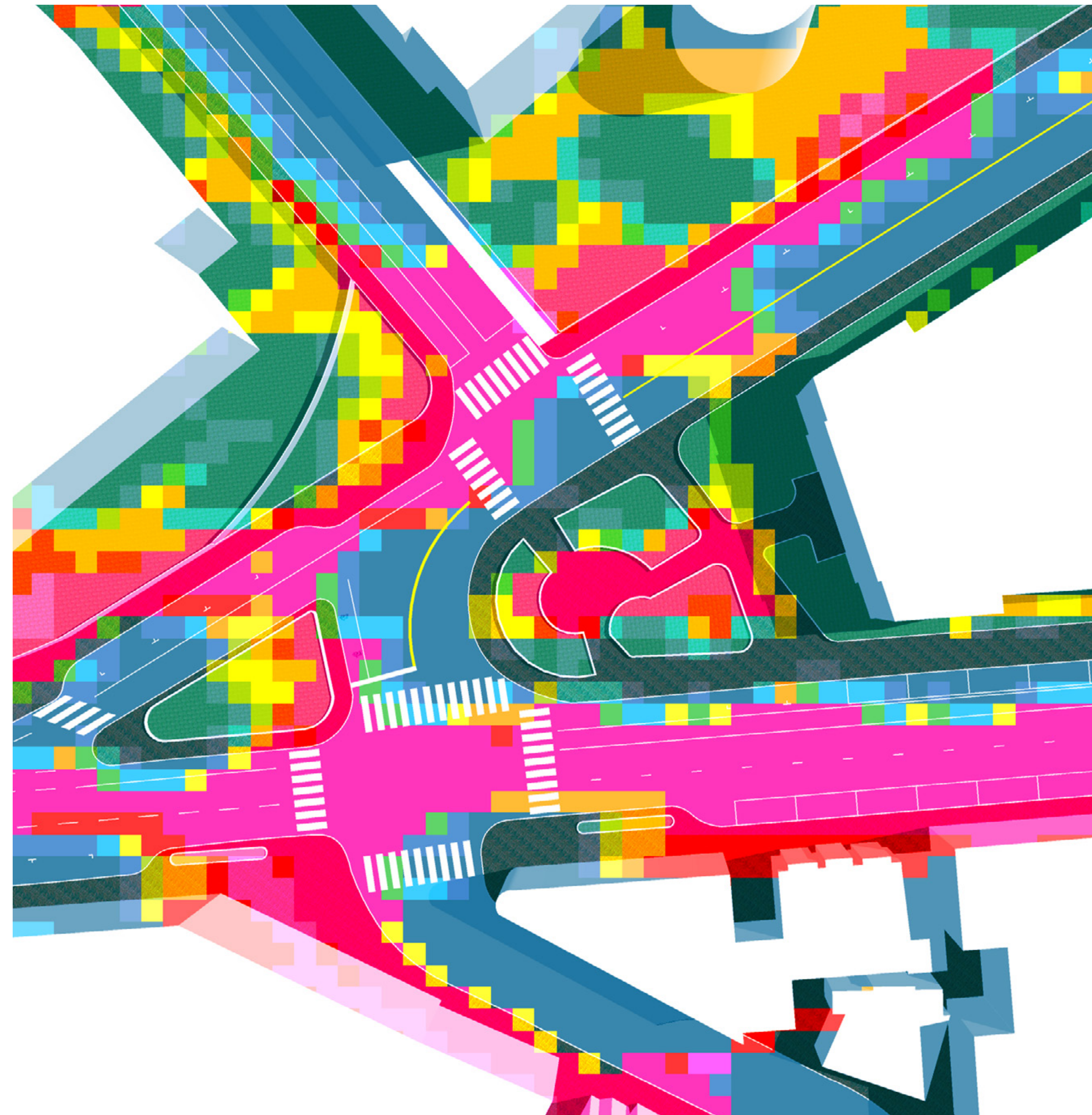
Existing Conditions



Final Design Proposal

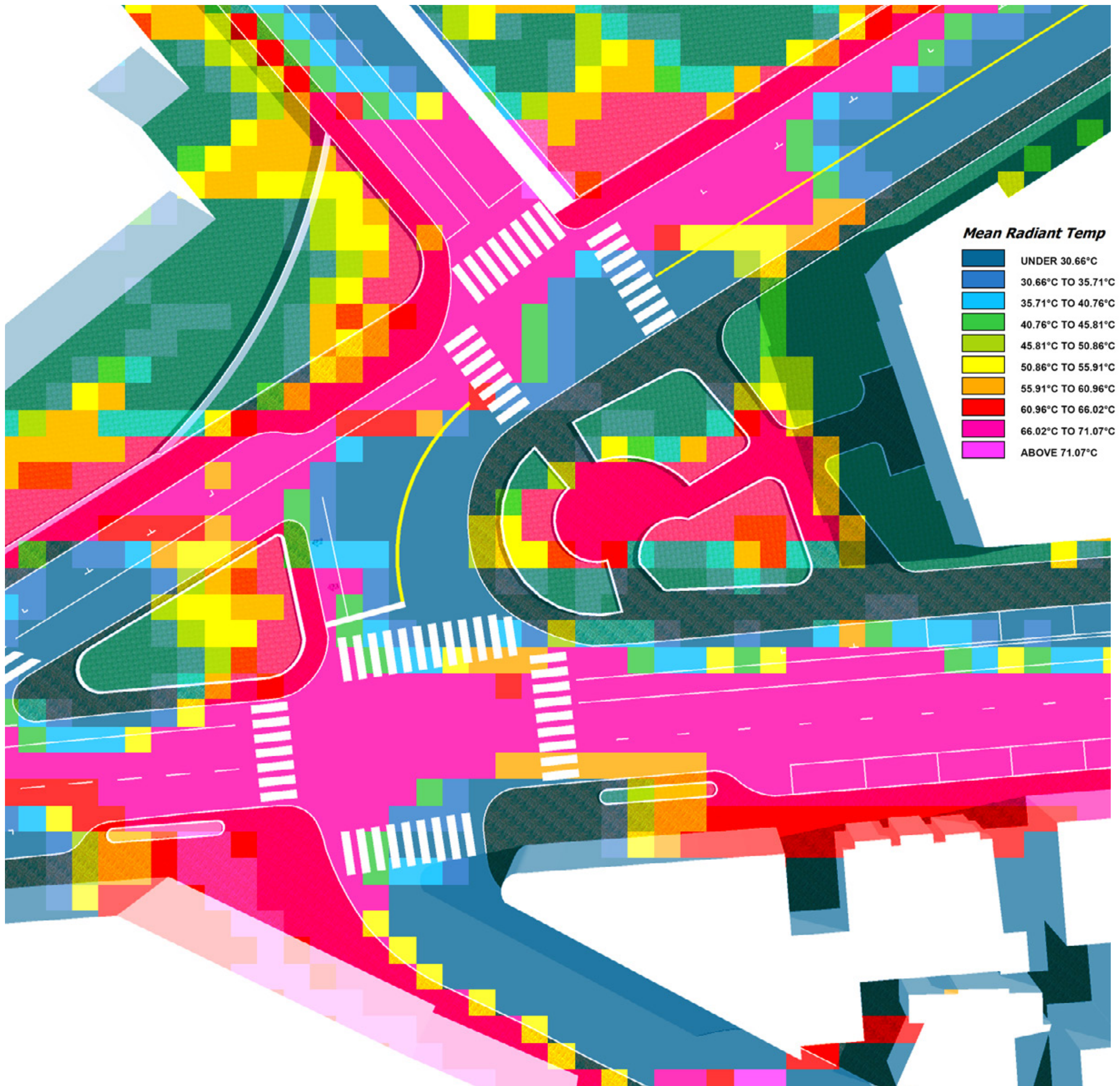
Existing Conditions



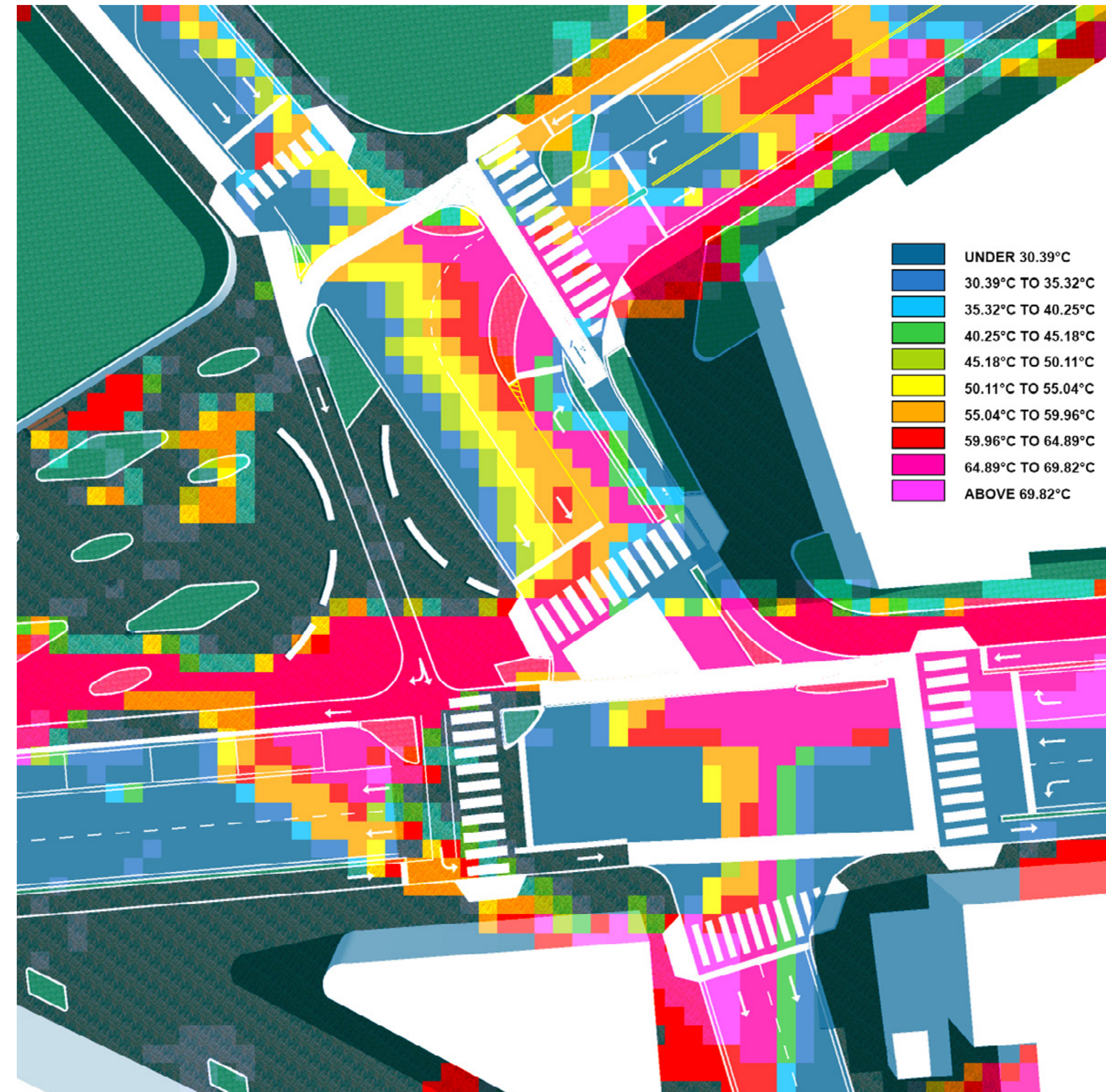


OUTDOOR THERMAL COMFORT

July 19 (Hottest Day) at 10am

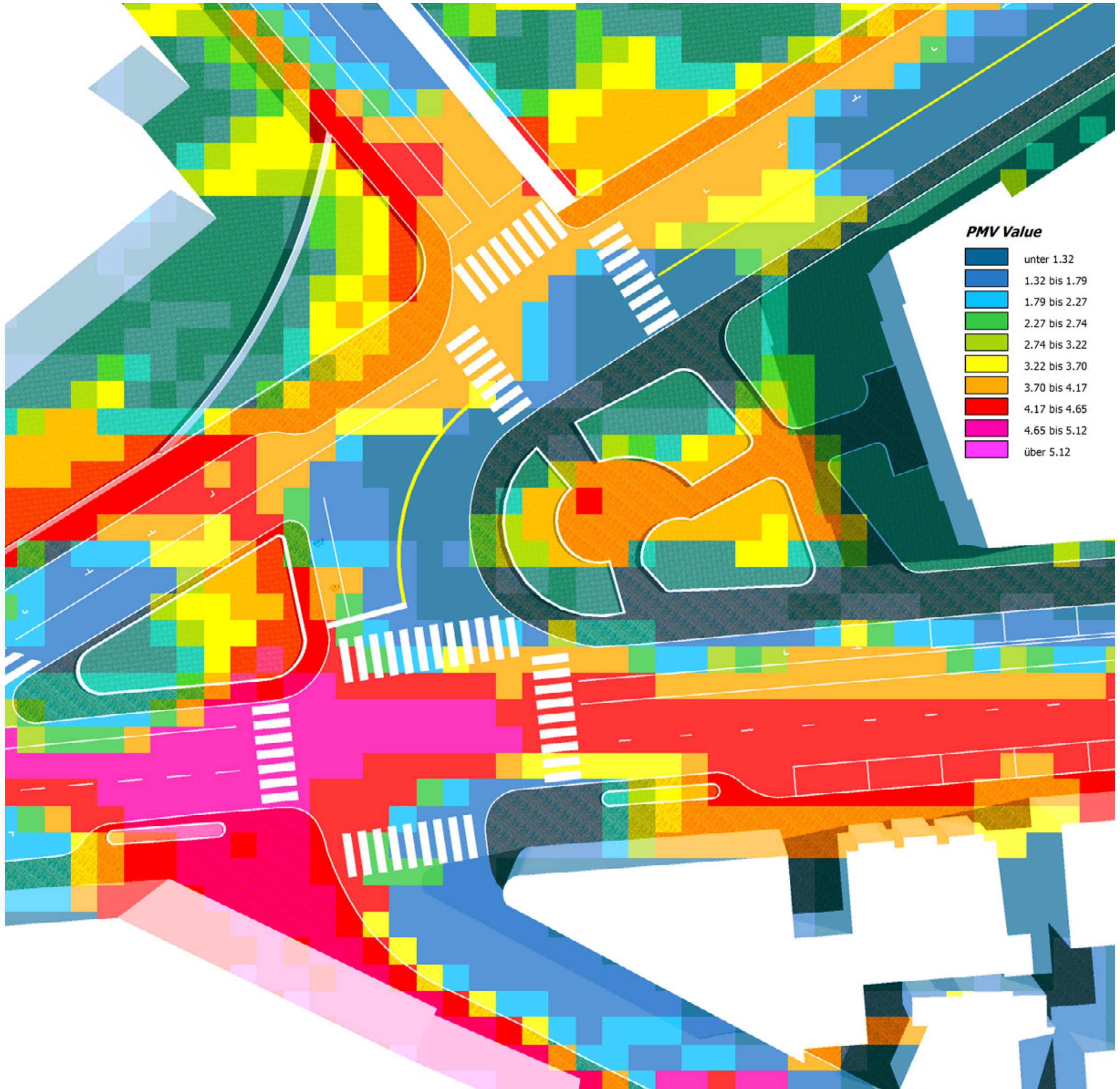


Existing Conditions | **Intersection 1** | MRT

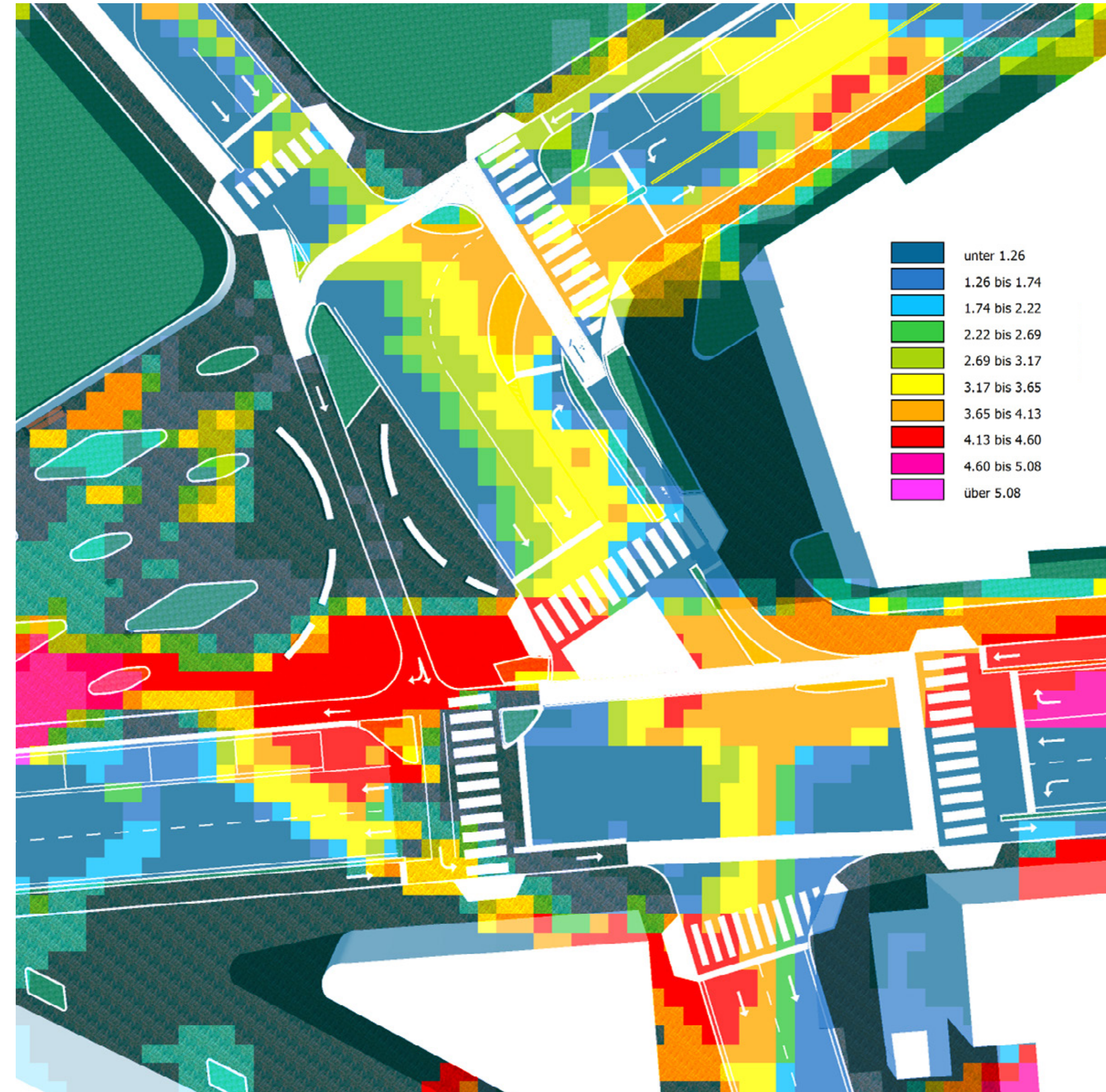


Final Design Proposal | **Intersection 1** | MRT

July 19 (Hottest Day) at 10am

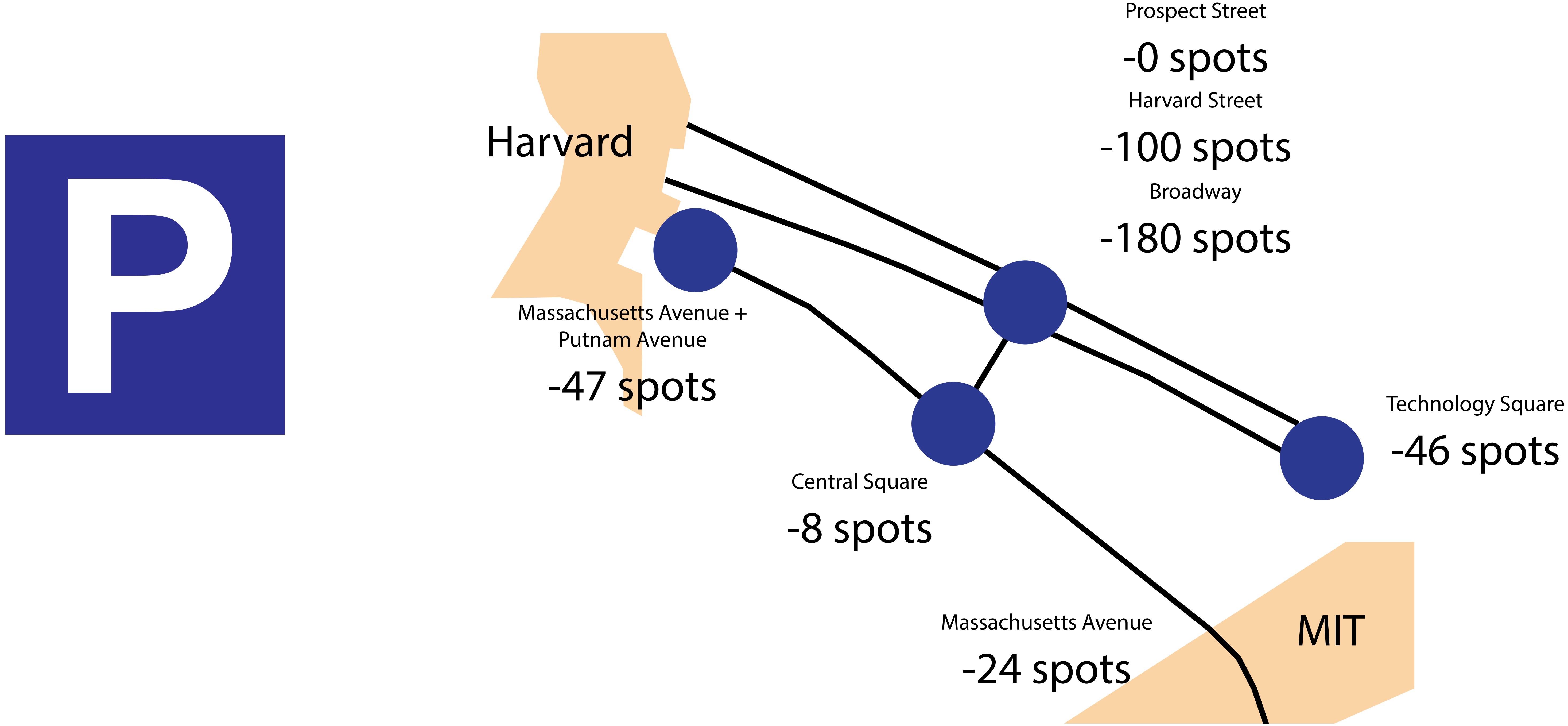


Existing Conditions | **Intersection 1** | PMV



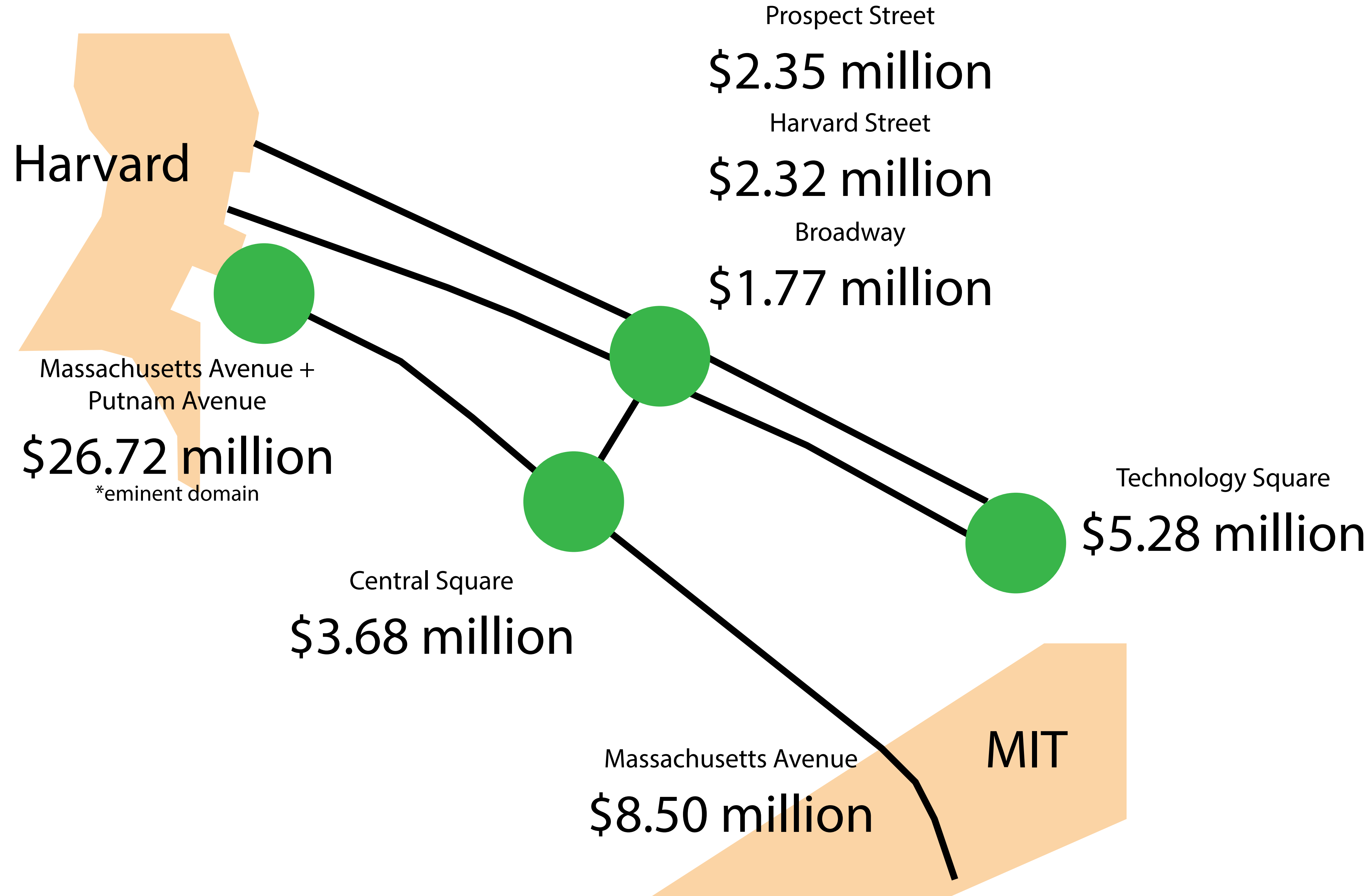
Final Design Proposal | **Intersection 1** | PMV


HARVARD
SOMERVILLE
BROADWAY ST
HARVARD ST
PROSPECT ST
MASS AVE
CAMBRIDGEPORT
MIT



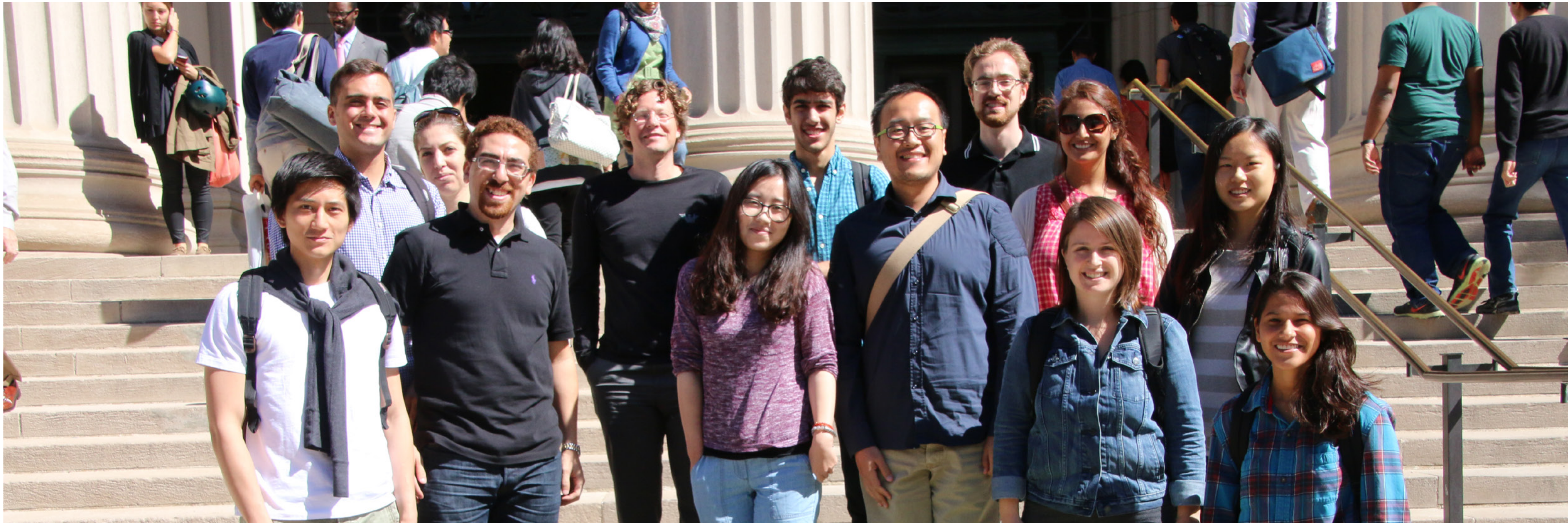
PARKING

reductions and modifications



COSTS

site interventions and extensions



A NEW BIKE ROUTE BETWEEN MIT AND HARVARD

Seminar Project

[INSTRUCTORS] TAREK RAKHA, CHRISTOPH REINHART

[STUDENTS] MARIANA BALLINA, KRISTINA ELDRENKAMP, CHINGWEN HSIAO, ALI IRANI, NATHANIEL JONES, MANOS SARATSIS, YUE SHAO, FENG SHEN, TOON VIROCHPOKA, LIUWEI ZHAO