

East Massachusetts Avenue

Pleasant St. & Maple St.

Roundabout Concept Analysis

Andy Paul + Ed Myers, PE
January 19, 2016
Public Meeting



KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

East Mass Ave: Project Timeline

To date-

- **2005 TSAC (Traffic Safety Advisory Committee) engaged due to public concerns**
- **2008 Town Commissioned Traffic Safety Study**
- **2012 Public workshop held and Town Meeting funded 25% design**
- **2013 Public workshop held**
- **2014 Town Meeting funded 100% design**
- **May 7th, 2015 25% Design Public Hearing held**
- **January 11th, 2016 Kittelson presented roundabout findings to Board of Selectmen**

Scheduled-

- **January 19th, 2016 Kittelson public presentation**
- **January 25th, 2016 Board of Selectmen to make design decisions**
- **2016 Replace aging and deteriorating water mains**
- **Fall 2016 Scheduled MassDOT project advertising**

* Numerous other meetings have been held both formal and informal with various stakeholders.



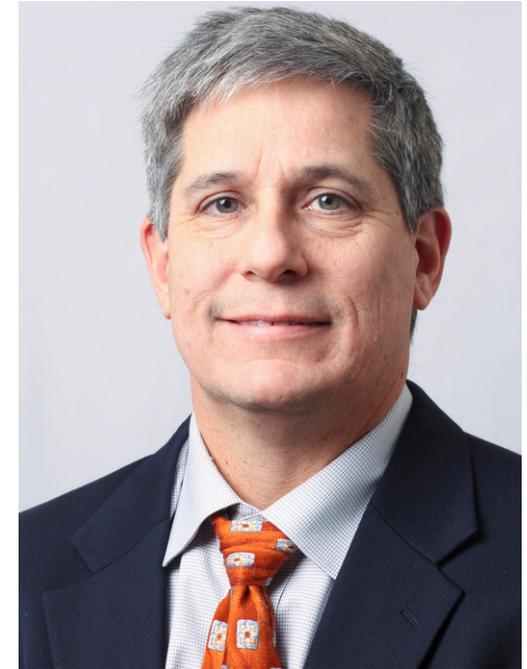
KAI Roundabout Qualifications

- **Over 20 years of roundabout project experience**
 - Total of over 700 feasibility, peer review, and/or final design projects involving roundabouts
 - On-call roundabout contracts with seven state DOTs
 - Recently awarded a roundabout on-call contract with MassDOT
- **Lead author of comprehensive roundabout research**
 - NCHRP Report 572: Applying Roundabouts in the United States
 - NCHRP Report 672: Roundabouts: An Informational Guide
- **Training**
 - 80 courses taught in 22 states and 2 foreign countries
 - 6 courses taught in 2015 in Massachusetts
- **Ongoing research**
 - NCHRP Project 20-05: Roundabout Practice in the U.S.
 - NCHRP Project 17-70: Development of Roundabout Crash Prediction Models and Methods



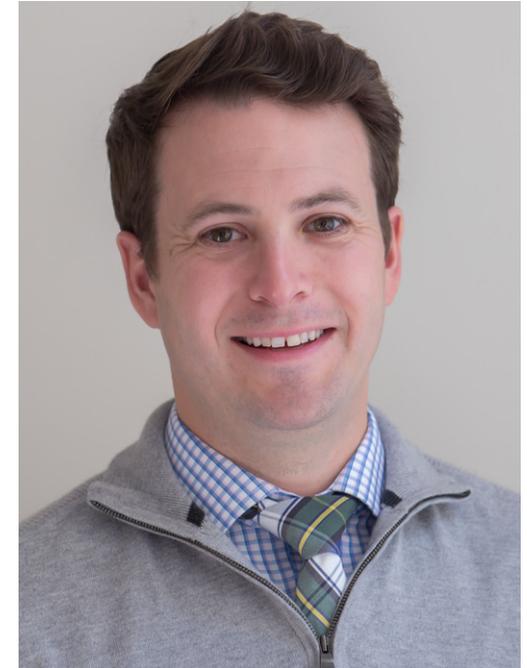
Ed Myers, PE

- **Senior Principal**
- **More than 30 years of engineering experience**
 - Project manager of on-call roundabout contracts for state DOTs in Maryland, Kansas, and Pennsylvania
 - Project manager of NCHRP 3-78: Crossing solutions at roundabouts and channelized turn lanes for pedestrians with vision disabilities
 - Designer of record for first 15 roundabouts in Maryland
 - Instructor of a variety of roundabout short courses
 - Author of first roundabout design guide in Maryland and NCHRP Reports 572 and 672



Andy Paul

- **12 years of engineering experience**
 - 45 roundabout projects
 - 30 roundabouts in Massachusetts
 - **First multilane lane roundabout in Massachusetts**
 - 5 rotary retrofit designs in Massachusetts
 - Roundabout design course instructor
 - **Taught six roundabout courses in Massachusetts in 2015**
- **11 Years at MassDOT**
 - District 3 Traffic Engineering Section
 - MassDOT Traffic Engineering Section
 - **Served as the State Roundabout Coordinator**
 - MassDOT Highway Design Section

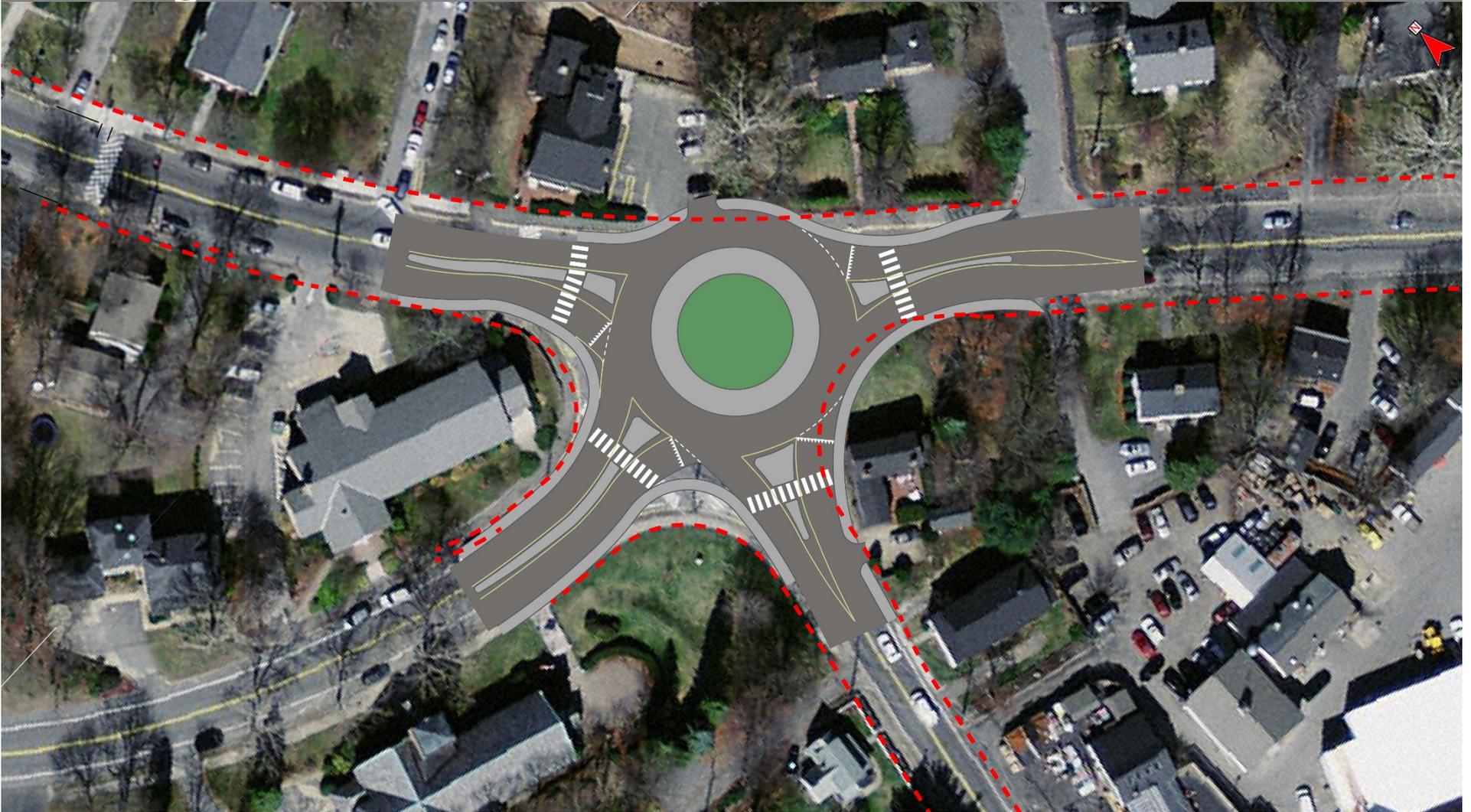


Why Are We Here?

- **Roundabout Concepts at Maple St and Pleasant St**
 - Conceptual design
 - Traffic analysis
- **Comparing Roundabouts and Traffic Signals**
 - Cost
 - Right of way impacts
 - Safety
- **Roundabouts vs. Rotaries**
- **Pedestrians at Roundabouts**
- **Cyclists at Roundabouts**

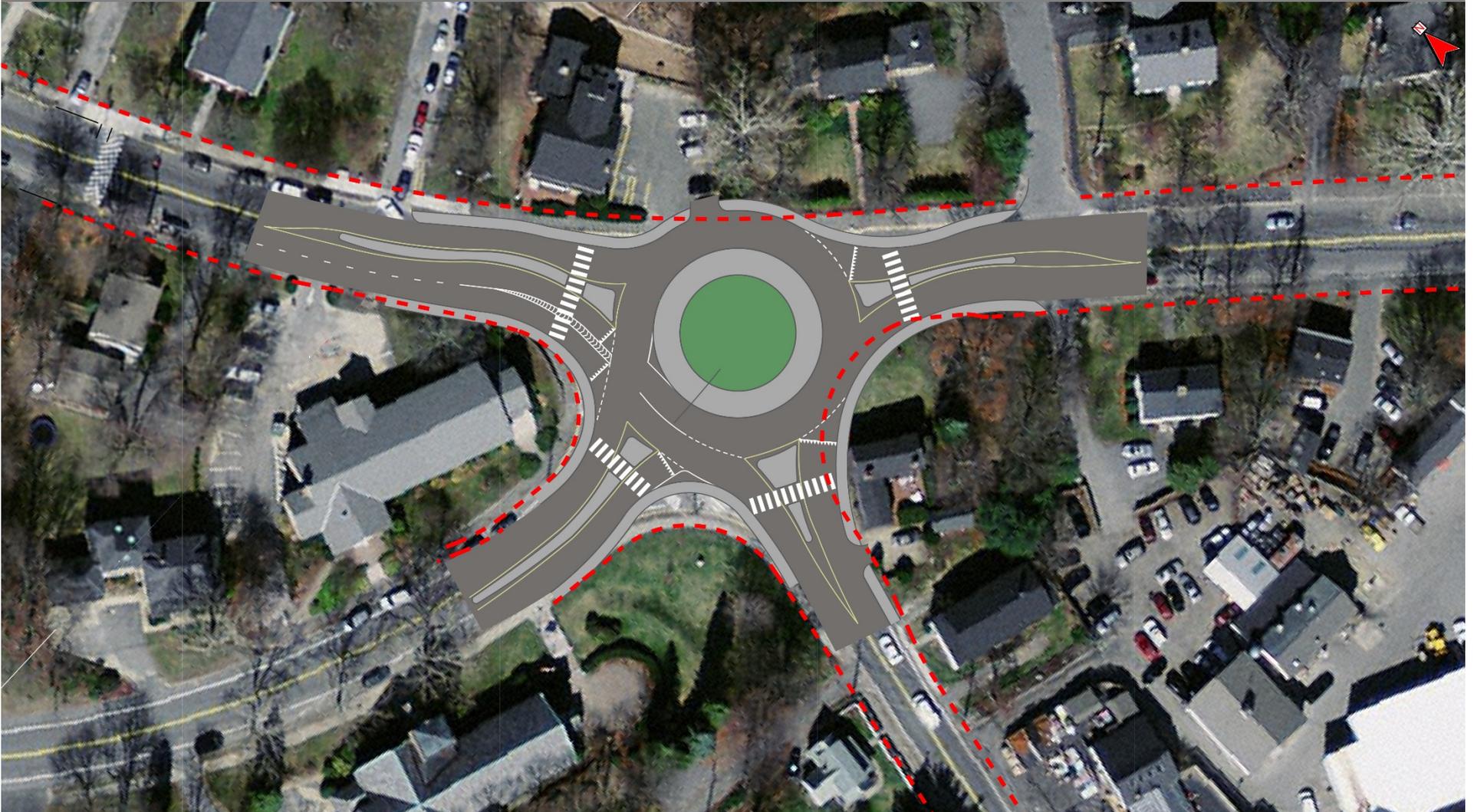


Pleasant St. at Massachusetts Avenue Single Lane Roundabout



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Pleasant St. at Massachusetts Avenue Multi-lane Roundabout



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Roundabout Traffic Analysis: Pleasant Street

Single-lane Roundabout

2023 Morning		
	Average Delay (s)	Average Queue (ft.)
Mass Ave NB	23	115
Mass Ave SB	74	560
Pleasant St	8	22
Follen Rd	13	7

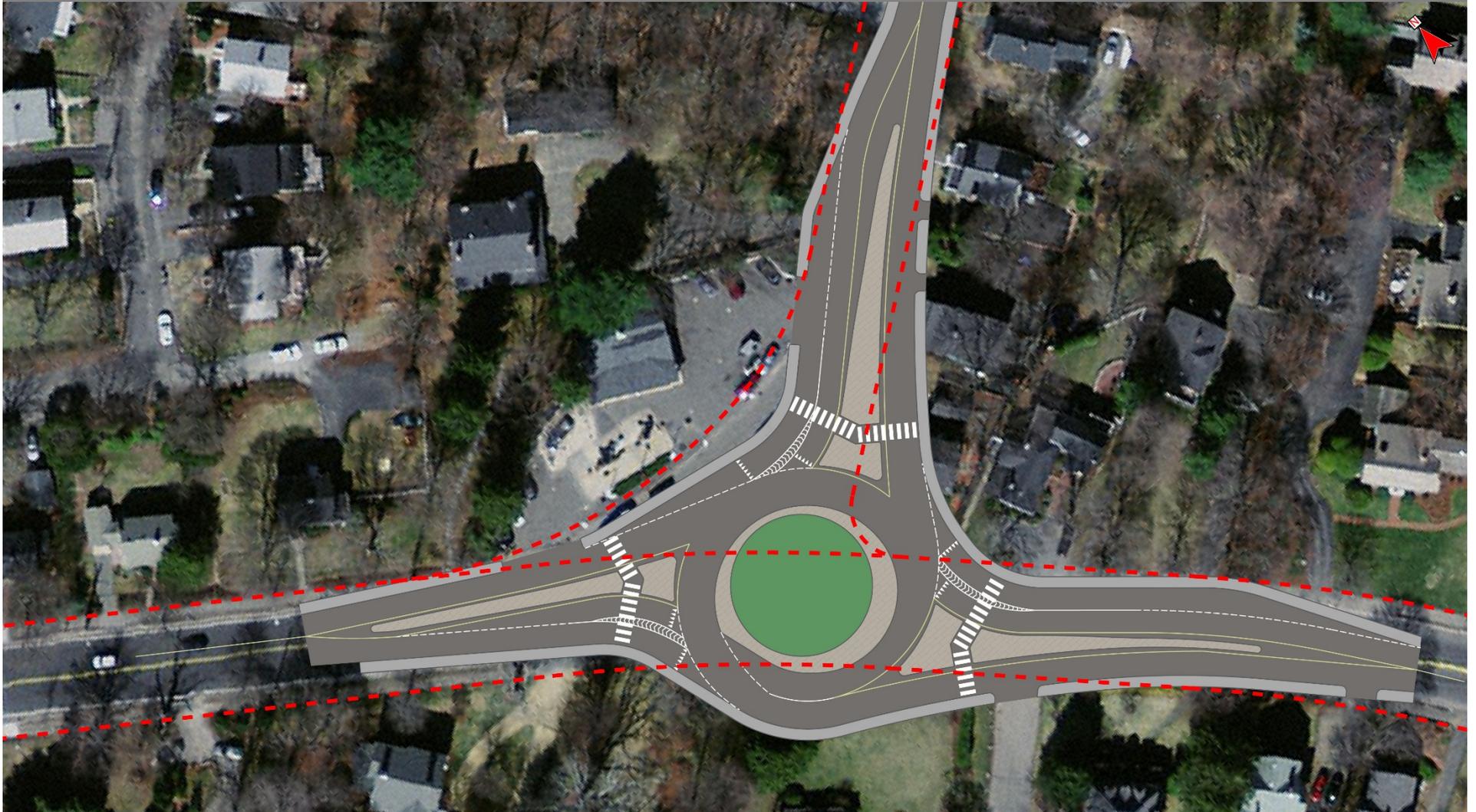
Multi-lane Roundabout

2023 Morning		
	Average Delay (s)	Average Queue (ft.)
Mass Ave NB	23	115
Mass Ave SB	13	75
Pleasant St	8	22
Follen Rd	11	5

2023 Evening		
	Average Delay (s)	Average Queue (ft.)
Mass Ave NB	15	87
Mass Ave SB	14	57
Pleasant St	14	50
Follen Rd	8	2

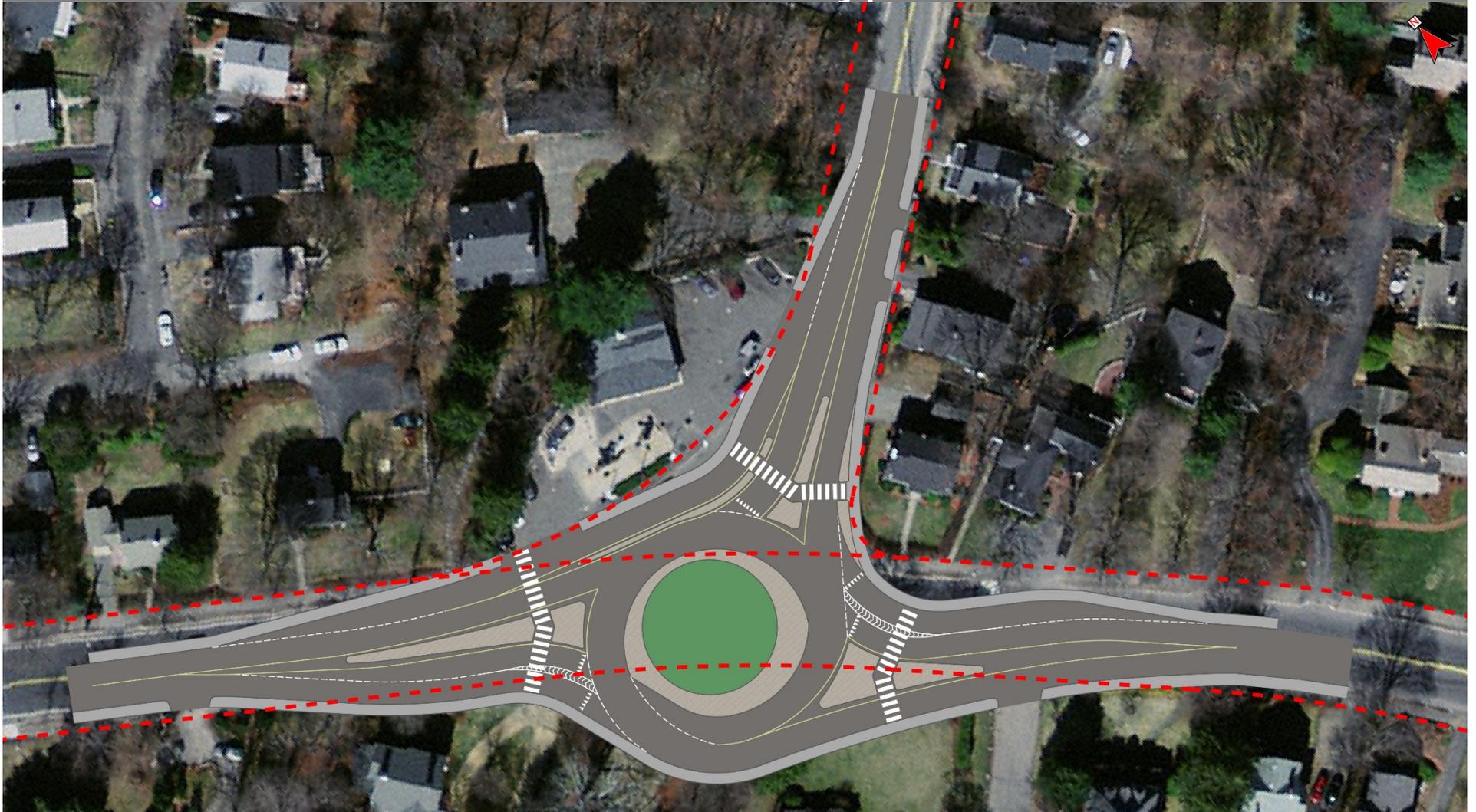
2023 Evening		
	Average Delay (s)	Average Queue (ft.)
Mass Ave NB	14	57
Mass Ave SB	6	22
Pleasant St	14	50
Follen Rd	7	2

Maple Street at Massachusetts Avenue Multi-lane Roundabout



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Maple Street at Massachusetts Avenue Multi-lane Roundabout with Bypass Lane



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Roundabout Traffic Analysis: Maple Street - Multilane Roundabout w/ Bypass

Single-lane Roundabout

Multi-lane Roundabout

2023 Morning		
	Average Delay (s)	Average Queue (ft.)
Mass Ave NB	24	150
Mass Ave SB	121	1,000
Maple Street	203	850

2023 Morning	
Average Delay (s)	Average Queue (ft.)
11	57
53	447
19	60

2023 Evening		
	Average Delay (s)	Average Queue (ft.)
Mass Ave NB	175	1,000
Mass Ave SB	158	1,375
Maple Street	12	25

2023 Evening	
Average Delay (s)	Average Queue (ft.)
25	115
11	57
8	12



Comparison: Roundabout and Signal

- **Traffic Operations**
- **Cost**
- **Right of way**
- **Safety**



Comparison: Roundabout and Signal – Traffic Ops Maple Street w/ Bypass

Multi-lane Roundabout

2023 Morning		
	Average Delay (s)	Average Queue (ft.)
Mass Ave NB	11	57
Mass Ave SB	53	447
Maple Street	19	60

2023 Evening		
	Average Delay (s)	Average Queue (ft.)
Mass Ave NB	25	115
Mass Ave SB	11	57
Maple Street	8	12

Signal

2023 Morning	
Average Delay (s)	Average Queue (ft.)
24	328
23	563
36	161

2023 Evening	
Average Delay (s)	Average Queue (ft.)
60	484
45	470
35	133





LEGEND

Vehicle Queue Length:

- █ No Build Condition
- █ Signalization
- █ Single Lane Approach Roundabout
- █ Multi-Lane Approach Roundabout
- ## Vehicle Queue length (feet)



Maple Street - AM Peak Hour Queue Comparison
Massachusetts Avenue
Lexington, Massachusetts



LEGEND

Vehicle Queue Length:

- █ No Build Condition
- █ Signalization
- █ Single Lane Approach Roundabout
- █ Multi-Lane Approach Roundabout
- ## Vehicle Queue length (feet)



Maple Street - PM Peak Hour Queue Comparison
Massachusetts Avenue
Lexington, Massachusetts



Comparison: Roundabout and Signal – Traffic Ops Pleasant Street

Multi-lane Roundabout

2023 Morning		
	Average Delay (s)	Average Queue (ft.)
Mass Ave NB	23	115
Mass Ave SB	13	75
Pleasant St	8	22
Follen Rd	11	5

2023 Evening		
	Average Delay (s)	Average Queue (ft.)
Mass Ave NB	14	57
Mass Ave SB	6	22
Pleasant St	14	50
Follen Rd	7	2

Signal

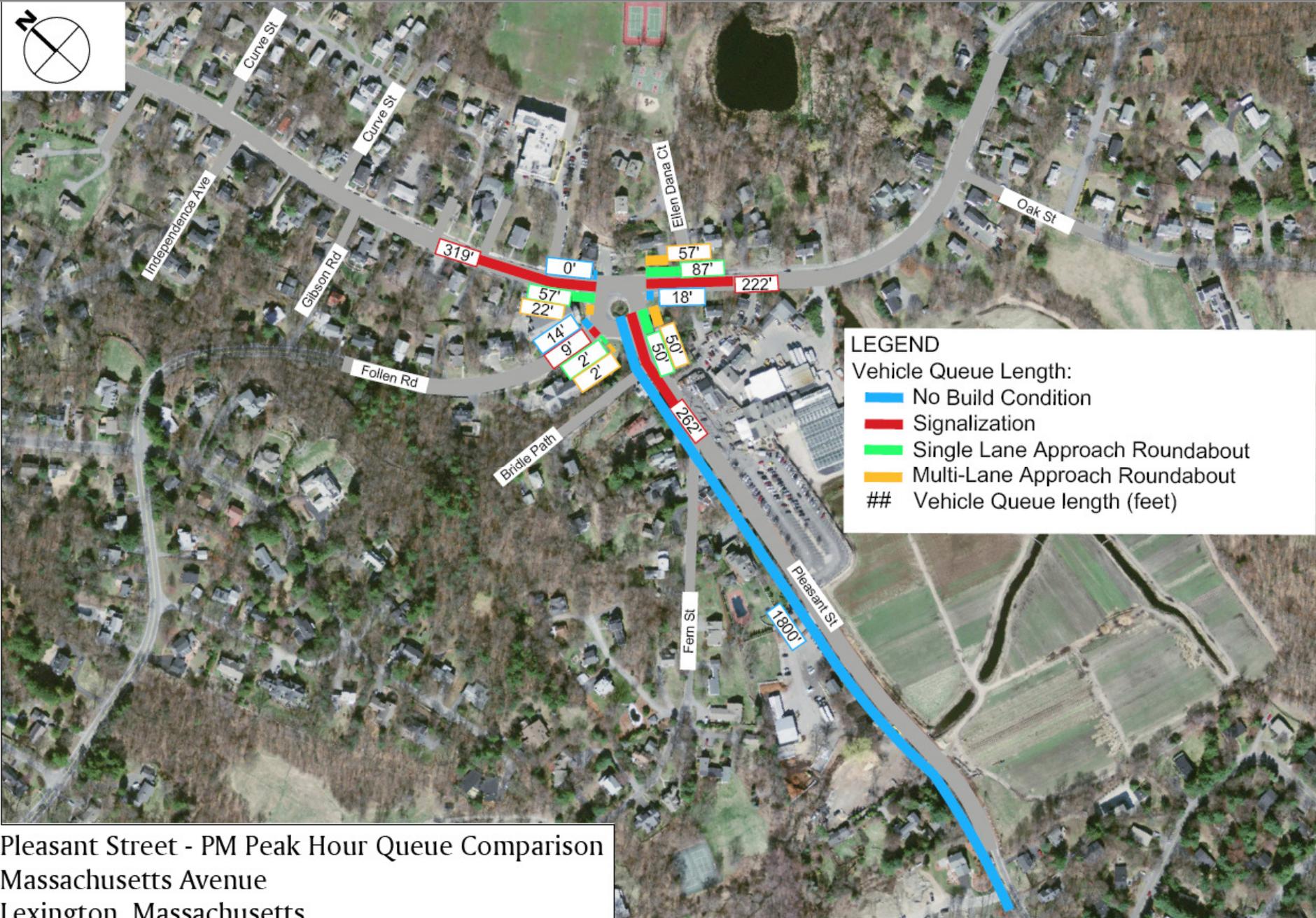
2023 Morning	
Average Delay (s)	Average Queue (ft.)
9	111
14	101
18	99
-	-

2023 Evening	
Average Delay (s)	Average Queue (ft.)
14	124
11	185
21	144
-	-



Pleasant Street - AM Peak Hour Queue Comparison
 Massachusetts Avenue
 Lexington, Massachusetts





Pleasant Street - PM Peak Hour Queue Comparison
 Massachusetts Avenue
 Lexington, Massachusetts



Comparison: Roundabout and Signal - Cost

Mass Ave at Maple Street - w/ Bypass	
	Cost (\$)
Roundabout	1,295,000
Signal	578,000

Mass Ave at Pleasant Street - Multilane	
	Cost (\$)
Roundabout	849,000
Signal	563,000

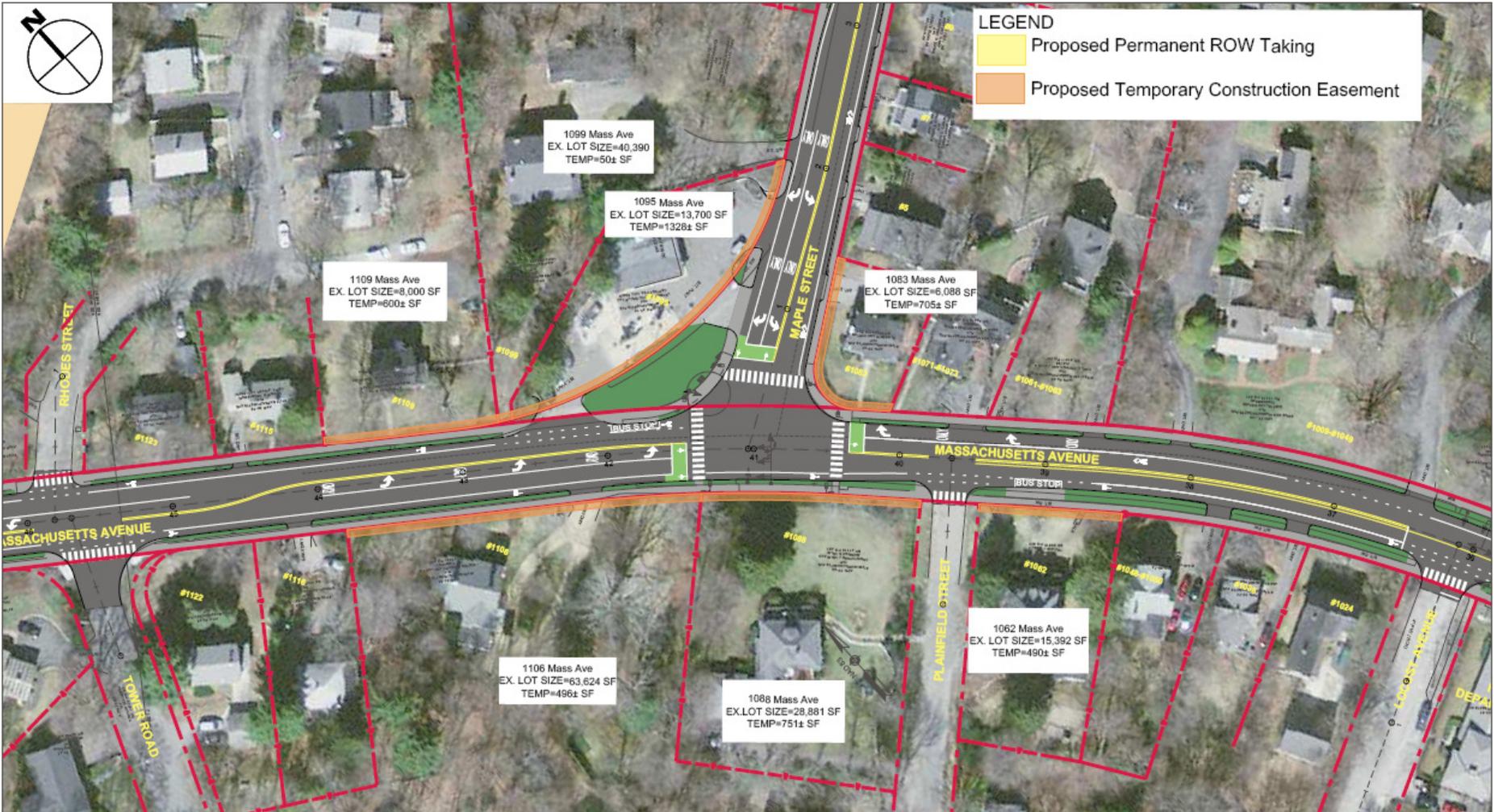


Comparison: Roundabout and Signal – R.O.W.

Mass Ave at Maple Street - w/ Bypass	
	Right of Way (sf)
Roundabout	10,455
Signal	0

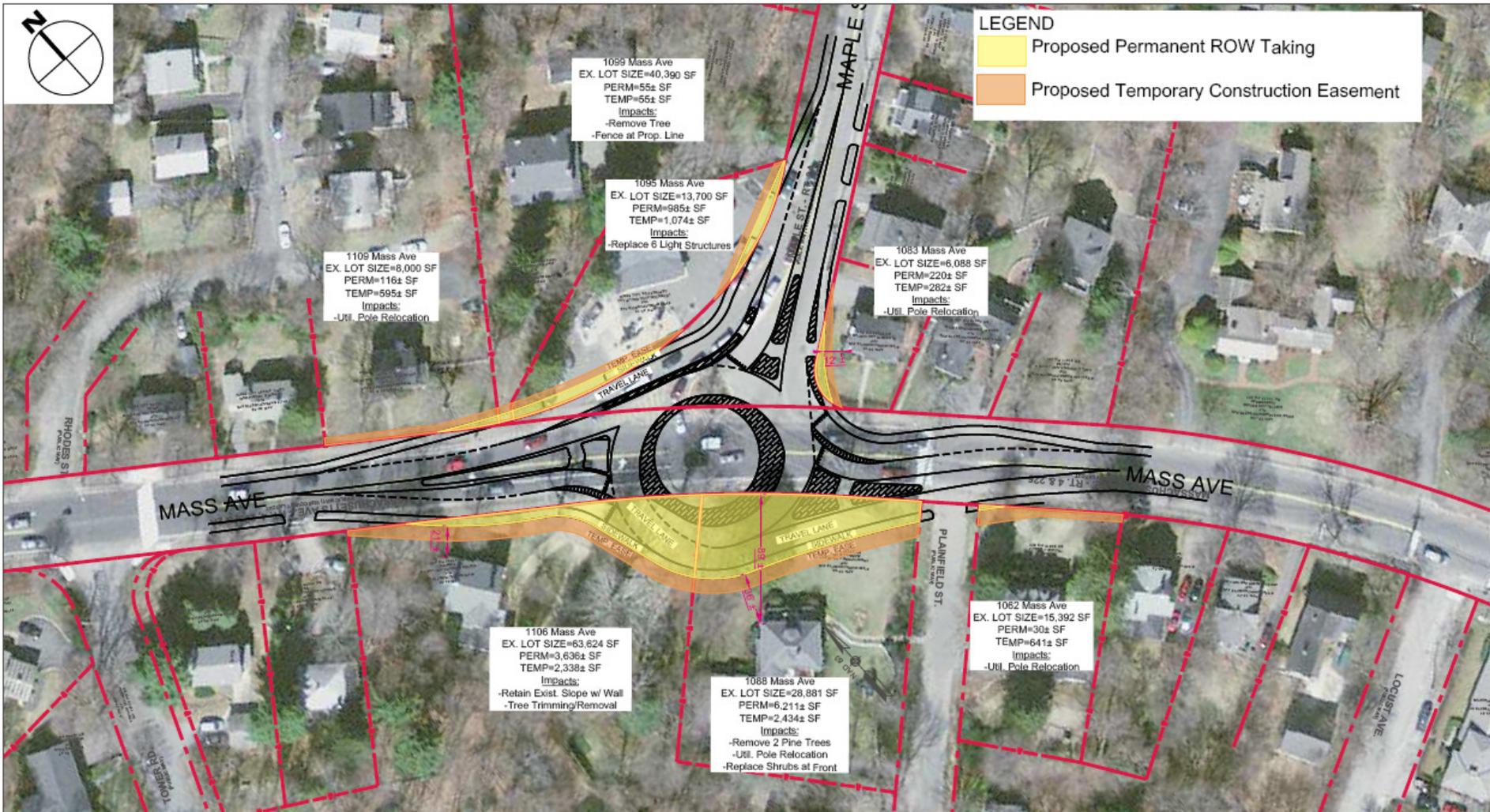
Mass Ave at Pleasant Street - Multilane	
	Right of Way (sf)
Roundabout	1,455
Signal	0





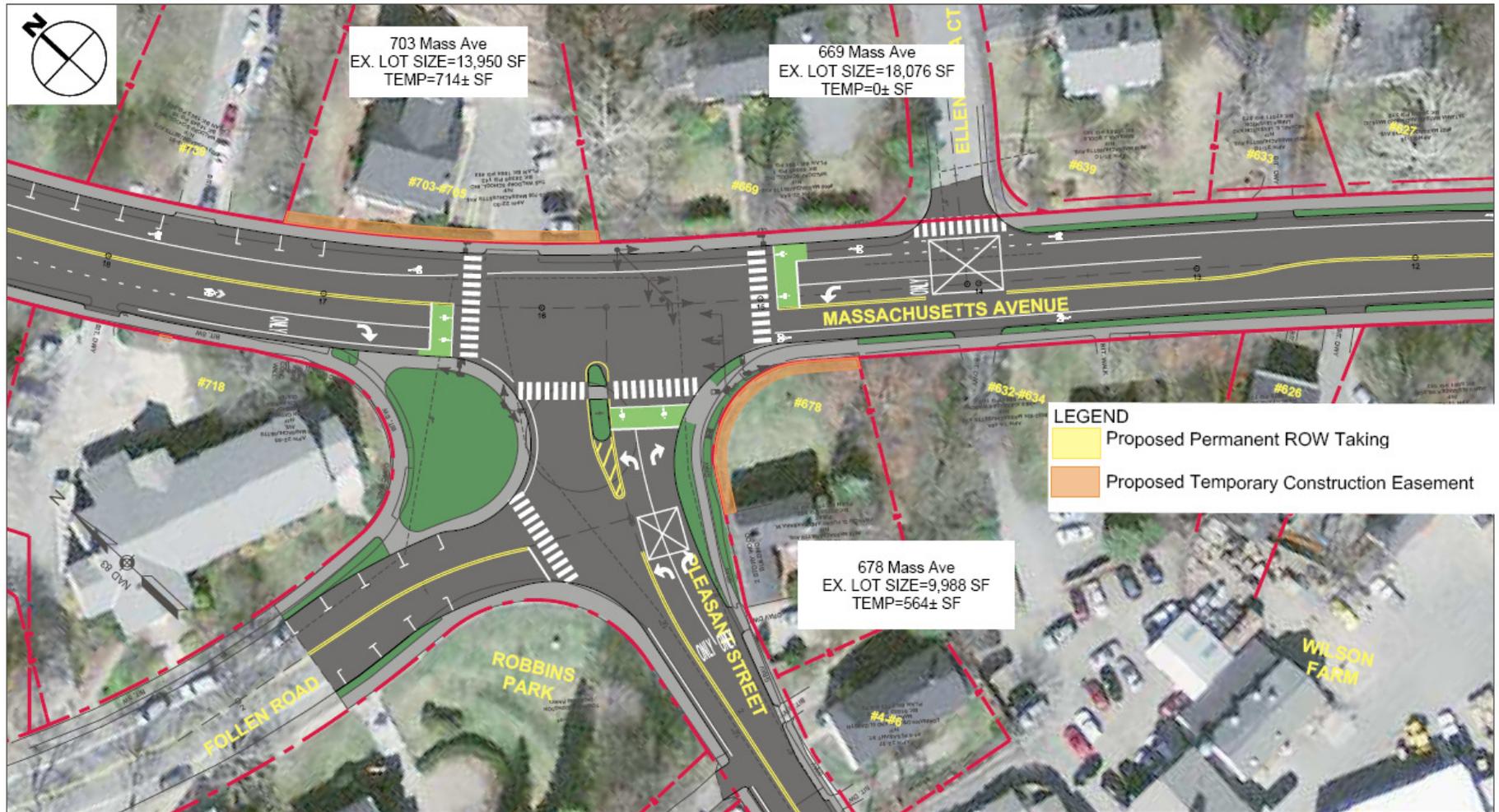
Maple Street - Signal ROW Impacts
 Massachusetts Avenue
 Lexington, Massachusetts





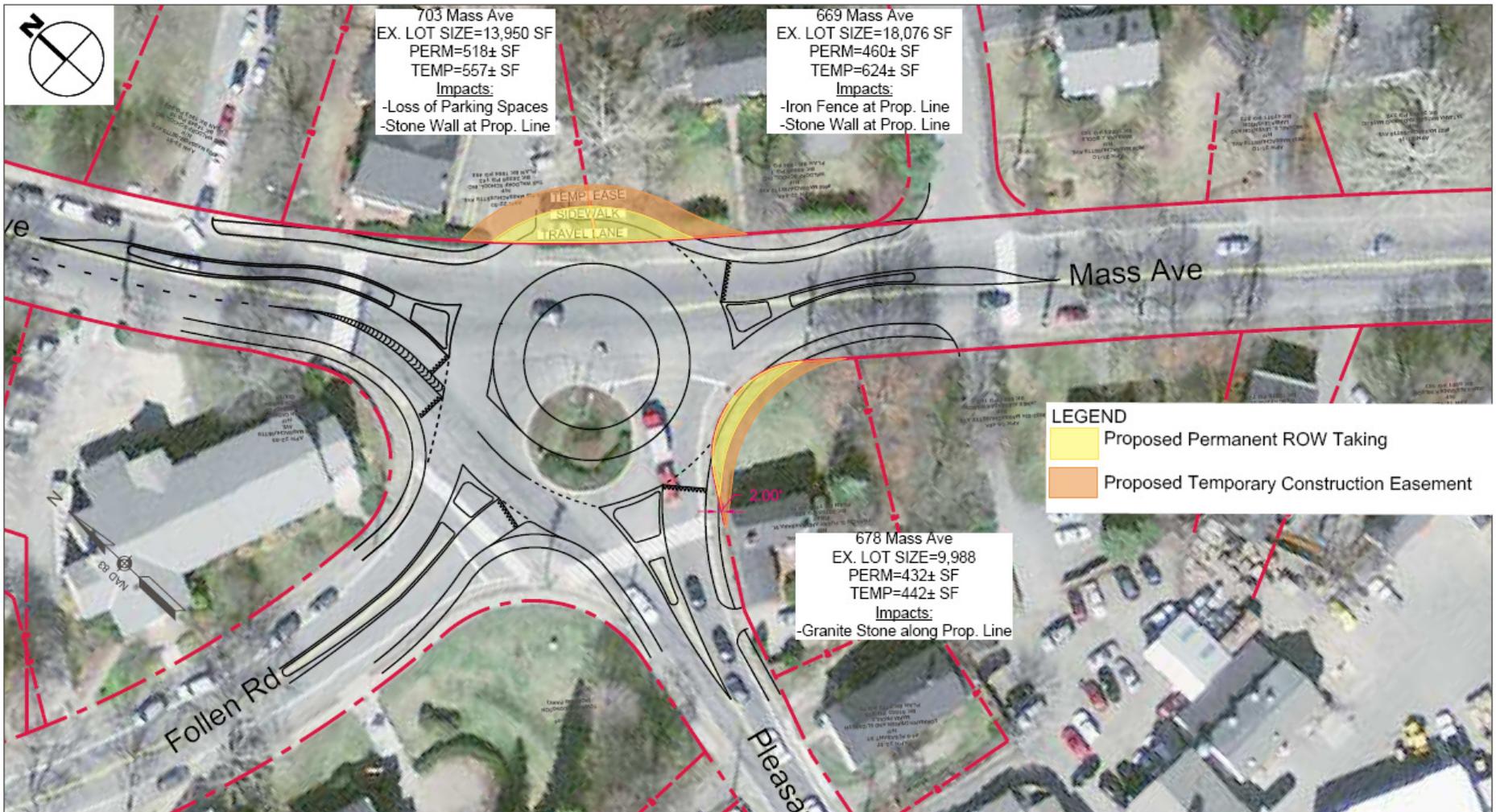
Maple Street - Roundabout ROW Impacts
 Massachusetts Avenue
 Lexington, Massachusetts





Pleasant Street - Signal ROW Impacts
Massachusetts Avenue
Lexington, Massachusetts





Pleasant Street - Roundabout ROW Impacts
 Massachusetts Avenue
 Lexington, Massachusetts

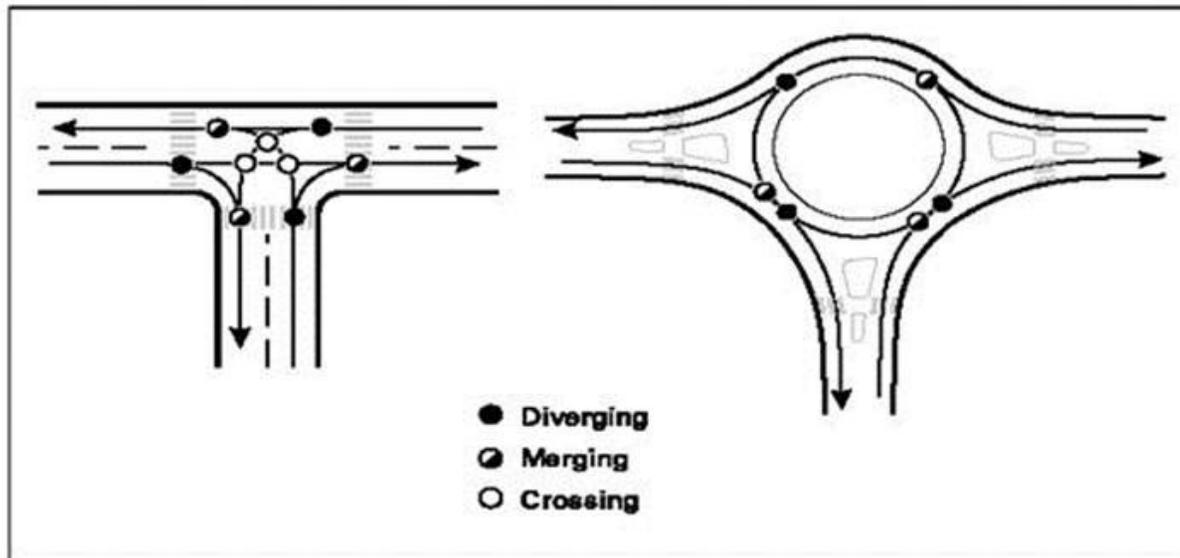


Comparison: Roundabout and Signal - Safety

- One of FHWA's *Nine Proven Safety Countermeasures*
- Fewer conflict points than signalized intersections
- Crashes at roundabouts are less severe due to the angle of collision

Traffic Signal

Roundabout



Comparison: Roundabout and Signal - Safety

- **Fewer conflict points than signalized intersections**

Maple Street:

- 33% fewer vehicle-to-vehicle conflict points
- 50% fewer vehicle-to-pedestrian conflict points

Pleasant

- 56% fewer vehicle-to-vehicle conflict points
- 50% fewer vehicle-to-pedestrian conflict points

Mass Ave at Maple Street			at Pleasant Street	
	Vehicle	Pedestrian	Vehicle	Pedestrian
Signal	9	12	18	16
Roundabout	6	6	8	8



Comparison: Roundabout and Signal - Safety

- **National Statistics from NCHRP Report 672**
 - Reduce fatal crashes by 90 percent
 - Reduce injury crashes by 75 percent
- **Fatal Crashes at ~4,000 US Roundabouts**
 - 32 Fatalities
 - 1 Bicyclist
 - 0 Pedestrians

NCHRP
REPORT 672

NATIONAL
COOPERATIVE
HIGHWAY
RESEARCH
PROGRAM

**Roundabouts:
An Informational Guide**

Second Edition

In Cooperation with

U.S. Department
of Transportation
Federal Highway
Administration

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES



KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

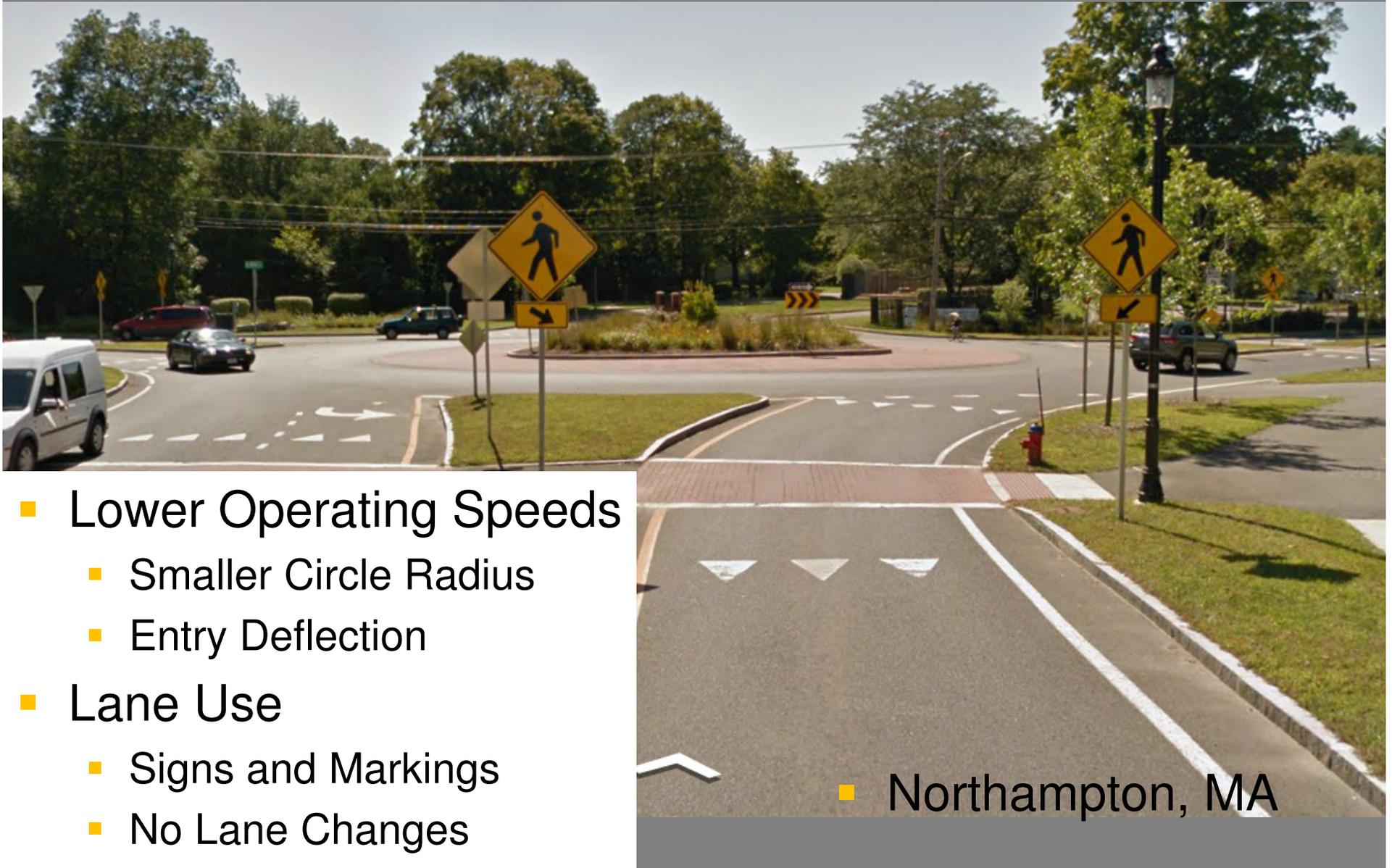
Comparison: Summary

Mass Ave at Maple Street				
	Traffic Operations	Cost (\$)	Right of Way (sf)	Safety
Roundabout	++	-	-	++
Signal	+	+	+	+

Mass Ave at Pleasant Street				
	Traffic Operations	Cost (\$)	Right of Way (sf)	Safety
Roundabout	+	-	-	++
Signal	+	+	+	+



Roundabouts vs. Rotaries



- Lower Operating Speeds
 - Smaller Circle Radius
 - Entry Deflection
- Lane Use
 - Signs and Markings
 - No Lane Changes

■ Northampton, MA

Roundabouts vs. Rotaries

- **Maximum speed of 25 mph**
- **Existing Mass Ave posted speeds of 35 mph**
- **Lower speeds at the roundabouts provide safer conditions for pedestrians and increase comfort for bicyclists**

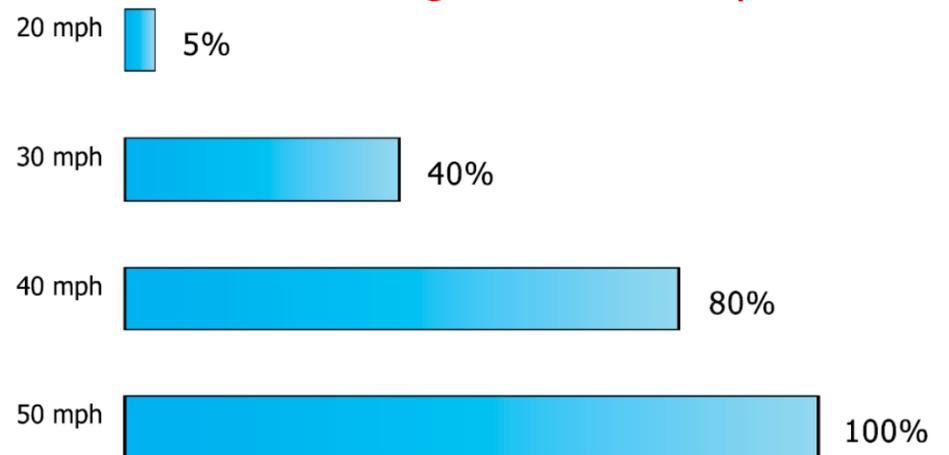


Pedestrians at Roundabouts

- Pedestrians cross only one direction at a time
- Pedestrian refuge area provided on every approach
- Reduced speed at crossing location



Chance of pedestrian fatality if hit by a vehicle traveling at various speeds



Bicycles at Roundabouts

- **Slower vehicle operating speeds make roundabouts safer and more comfortable for bicyclists**
- **Bicyclists can either use the roundabout as a vehicle or use dedicated ramps to access the crosswalks**



Bicycles at Roundabouts

- **MassDOT SBL Guide**
- **Chapter 4: Intersections, Exhibit 4A**

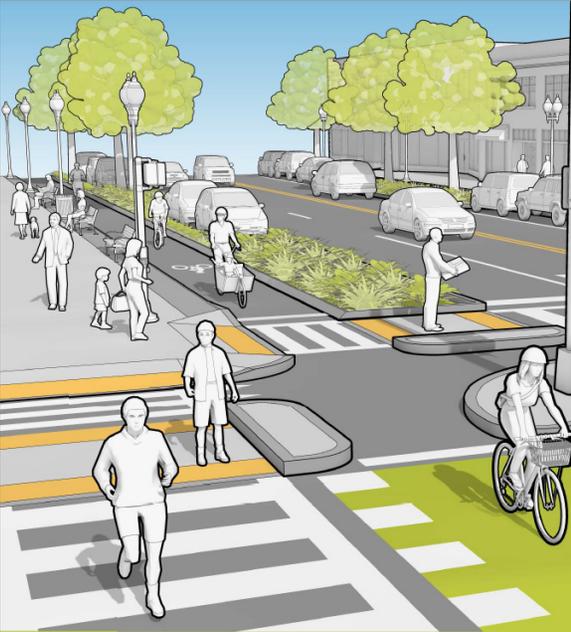
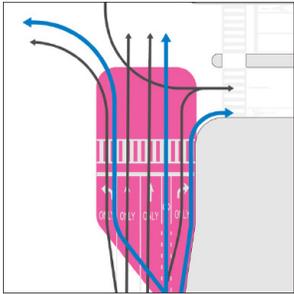
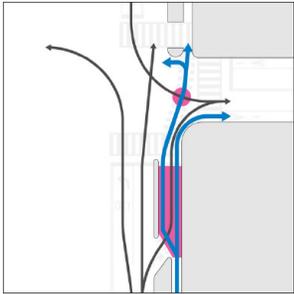
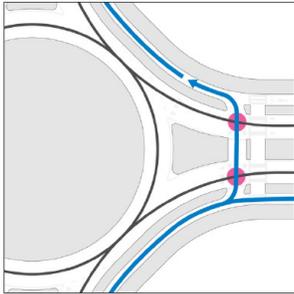
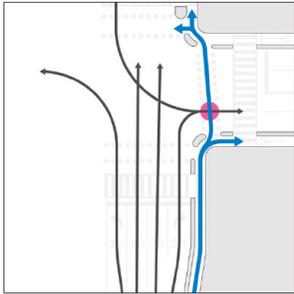


EXHIBIT 4A: COMPARISON OF BICYCLIST EXPOSURE AT INTERSECTIONS

The diagrams on this page provide a comparison of the levels of exposure associated with various types of intersection designs.

Exposure Level: High	Exposure Level: High to Medium	Exposure Level: Medium to Low	Exposure Level: Low
			
CONVENTIONAL BIKE LANES AND SHARED LANES	SEPARATED BIKE LANES WITH MIXING ZONES	SEPARATED BIKE LANES THROUGH ROUNDABOUTS	PROTECTED INTERSECTIONS

SEPARATED BIKE LANE
PLANNING & DESIGN GUIDE 2015 MASSACHUSETTS DEPARTMENT OF TRANSPORTATION

bicycle →
motor vehicle →
conflict area ●

Pedestrian Crossing Treatments at Multilane Roundabouts

- **Raised Crosswalks**
- **Rectangular Rapid Flash Beacon (RRFB)**
- **Pedestrian Hybrid Beacon (HAWK)**



Raised Crosswalk



Rectangular Rapid Flashing Beacon (RRFB)



Pedestrian Hybrid Beacon



Summary

- **Roundabouts at Maple Street and Pleasant Street**
 - Conceptual design
 - Traffic analysis
- **Comparing Roundabouts and Traffic Signals**
 - Cost
 - Right of way impacts
 - Safety
- **Roundabouts vs. Rotaries**
- **Pedestrians at Roundabouts**
- **Cyclists at Roundabouts**



Questions and Comments

- **To send comments email:**
 - selectmen@lexingtonma.gov
- **Project website:**
 - <http://www.lexingtonma.gov/engineering/pages/east-mass-ave-roadway-improvements-project>

