# MONTACHUSETT REGIONAL *ROUNDABOUTS AND THE MRPC REGION REPORT*

## Roundabout Basics & Roundabout History in the MRPC Region

Montachusett Regional Planning Commission

Prepared in cooperation with the Massachusetts Department of Transportation and the U.S. Department of Transportation. The views and opinions of the Montachusett Regional Planning Commission expressed herein do not necessarily state or reflect those of the Massachusetts Department of Transportation or the U.S. Department of Transportation.

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**Route 12 at Chocksett Road, Sterling:**
**Extensive Use of APPROACH DEFLECTION Helps Reduce Speed of Entering Vehicles**

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# MONTACHUSETT REGIONAL
# ROUNDABOUTS AND THE MRPC REGION

## Roundabout Basics & Roundabout History in the MRPC Region

Prepared by the
Montachusett Regional Planning Commission (MRPC)
for the
Montachusett Metropolitan Planning Organization (MMPO)

FFY 2021 Program Year

September 2021

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Montachusett Metropolitan Planning Organization (MMPO)
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Title VI Coordinator
MRPC
464 Abbott Ave.
Leominster, MA 01453
(978) 345-7376
geaton@mrpc.org

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One Ashburton Place, 6th Floor
Boston, MA 02109
617-994-6000 ~~ TTY: 617-994-6196

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| | |
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| MassDOT Highway Division Administrator | Jonathan L. Gulliver |
| Montachusett Regional Planning Commission (MRPC) Chairman | Guy Corbosiero |
| Montachusett Regional Transit Authority (MART) Chairman/Mayor City of Fitchburg | Mayor Stephen DiNatale |
| Mayor City of Gardner | Mayor Michael J. Nicholson |
| Mayor City of Leominster | Mayor Dean Mazzarella |
| Winchendon Board of Selectmen *Subregion 1* | Barbara Anderson |
| Ashburnham Board of Selectmen *Subregion 2* | Rosemarie Meissner |
| Lunenburg Board of Selectmen *Subregion 3* | Michael-Ray Jeffreys |
| Lancaster Board of Selectmen *Subregion 4* | Jason Allison |

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Arthur Frost, Project Development Engineer for Administrator Jonathan L. Gulliver
Glenn Eaton, Executive Director, MRPC, for Chairman Guy Corbosiero
Bruno Fisher, Interim Administrator, MART, for Chairman Mayor Stephen DiNatale

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| | |
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| Jeffrey H. McEwen, Administrator | Federal Highway Administration |
| Peter Butler, Acting Administrator | Federal Transit Administration |

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| Roger Hoyt, Vice Treasurer | Ashburnham |
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## MONTACHUSETT JOINT TRANSPORTATION COMMITTEE (MJTC) OFFICERS

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| Dick Kilhart, Vice Chairman | Athol |
| Guy Corbosiero, Secretary | Winchendon |

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Holly Ford, Administrative Manager
Linda Quinlivan, Fiscal Director
Christopher McNamara, Fiscal Assistant
Brad Harris, Transportation Project Director
George Snow, Principal Transportation Planner
Sheri Bean, Principal Planner
Brian Doherty, AICP, Principal Transportation Planner
Karen Chapman, Planning and Development Director
Jonathan Vos, Regional Planner
Christopher McDermott, Economic Development Manager
Jennifer Burney, Senior Planner
Jason Stanton, GIS & IT Director
Kayla Kress, GIS & IT Analyst
Blair Haney, Senior Planner
Meagen Donoghue, Senior Planner
Bruce Hughes, Senior Planner

# 2021-2022 APPOINTMENT LIST

## MONTACHUSETT JOINT TRANSPORTATION COMMITTEE

| COMMUNITY | APPOINTED BY SELECTMEN/MAYOR | APPOINTED BY PLANNING BOARD |
|---|---|---|
| Ashburnham | Rosemarie Meissner | Roger Hoyt |
| Ashby | | Alan Pease |
| Athol | Dick Kilhart | |
| Ayer | Shaun Copeland | Mark Archambault |
| Clinton | Phil Duffy | |
| Fitchburg | Nicolas Bosonetto | Paula Caron |
| Gardner | Trevor Beauregard | Robert Swartz |
| Groton | | Russell Burke |
| Harvard | Tim Kilhart | Stacia Donahue |
| Hubbardston | Travis Brown | Alice Livdahl |
| Lancaster | | Roy Mirabito |
| Leominster | David DiGiovanni | Peter Latchis |
| Lunenburg | Todd Dwyer | Matthew Brenner |
| Petersham | Nancy Allen | |
| Phillipston | Gordon Robertson | |
| Royalston | Roland Hamel | |
| Shirley | | Janet Tice |
| Sterling | Richard Maki | Kirsten Newman |
| Templeton | | Charles Carroll II |
| Townsend | Veronica Kell | Beth Faxon |
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| Winchendon | Brian Croteau | Guy Corbosiero |

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| | |
|---|---|
| | Office of Transportation Planning (OTP), Massachusetts Department of Transportation (MassDOT) |
| Jeffrey H. McEwen | Federal Highway Administration (FHWA), Administrator |
| Peter Butler | Federal Transit Administration (FTA), Acting Administrator |
| | Department of Environmental Protection (DEP) |
| Paula Simmons | MassDOT Highway Division - District 2 |
| Arthur Frost | MassDOT Highway Division - District 3 |
| | Montachusett Regional Planning Commission (MRPC) |
| Bruno Fisher | Montachusett Regional Transit Authority (MART) |

## ORGANIZATION MEMBERS

| | |
|---|---|
| Al Futterman | Nashua River Watershed Association (NRWA) |
| | Amalgamated Transit Union #690 (ATU 690) |
| Richard Liberatore | Fitchburg Airport Commission |
| Roy M. Nascimento | North Central MA Chamber of Commerce |
| Joan Goodwin | Fitchburg Council on Aging |
| Jessica Strunkin | Mass Development |
| Peter Lowitt | Devens Enterprise Commission (DEC) |
| | Montachusett Opportunity Council, Inc. |
| Joshua Preville | The ARC of Opportunity |

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# Executive Summary

Since 2011, eight (8) MRPC region member communities (Communities) have seen: The construction of seven (7) roundabouts; three (3) roundabouts are currently scheduled to be constructed by 2025; one (1) roundabout is a Community's preferred improvement alternative; and one (1) preexisting large diameter rotary has been retrofitted with roundabout design elements seeking to improve safety and operation at the rotary.  This report seeks to present these roundabouts and retrofitted rotary to other MRPC region member communities as examples to examine when considering improvement alternatives for a location.

This report has four (4) purposes that are examined in four (4) sections.  The first section is called **Roundabout Basics** and seeks to provide the reader with key up-to-date basic information about roundabouts based on the latest available developments.  The second section is called **CIs** (**C**ircular **I**ntersections) **in the MRPC Region** and seeks to provide the reader with the total number of CIs in the Communities which are then broken down by: Community; CI type (RAs = **R**ound**A**bouts; LDRs = preexisting **L**arge **D**iameter **R**otaries; and SDRs = preexisting **S**mall **D**iameter **R**otaries); and by PDS (**P**roject **D**evelopment **S**tatus).  The third section is called **LDRs & SDRs in the MRPC Region** and seeks to provide the reader with pertinent information concerning the previously mentioned and retrofitted LDR; two (2) LDRs located in two (2) Communities; and two (2) SDRs located in two (2) Communities.  This section also includes a link to the MassDOT ***Rotary Retrofits White Paper*** that pertains to the retrofitted LDR.  The fourth section is called **Roundabouts in the MRPC Region** and seeks to provide the reader with pertinent information on the previously mentioned 11 roundabouts.  All four (4) sections include extensive illustrated and textual information.

The **Roundabout Basics** section compares roundabouts to LDRs; provides descriptions of roundabout features such as the circulatory roadway, and bike and accessible pedestrian features; provides roundabout types based on size, daily traffic volume, and speed; and provides the ways safety and traffic flow can be improved when compared to a traditional intersection.  The source of much of the information is the recently released MassDOT ***Guidelines for the Planning and Design of Roundabouts*** (**GPDR**) which is linked in this section.  Other linked information in this section includes a video that addresses roundabout myths; a CI GIS database that provides relevant information on each location; and several links to traffic flow issues.

The pertinent information for the **LDRs & SDRs in the MRPC Region** and **Roundabouts in the MRPC Region** sections may include (if applicable): Image/Images; Location; Year Built; TIP Year; ICD (**I**nscribed **C**ircle **D**iameter); RA Status (Built/In Design); Retrofit Status (for LDRs - NA/In Design); RA Conversion Status (for SDRs - NA/In Design); Estimated Total Project Cost; Comment (unique to the facility); Link to Design Public Hearing Webinar;  Other Comment (as needed & unique to the facility).

For questions and comments on this report, please contact George Snow of our staff at:
Phone: 978-345-7376 x 312
Email: gsnow@mrpc.org

# What is a Roundabout (RA)?

It is "... a **Circular Intersection (CI)** in which traffic travels counterclockwise around a central island and entering traffic must yield to circulating traffic. The geometric features of a roundabout promote slow and consistent speeds for all movements." (**GPDR (introduced below), p 7**)

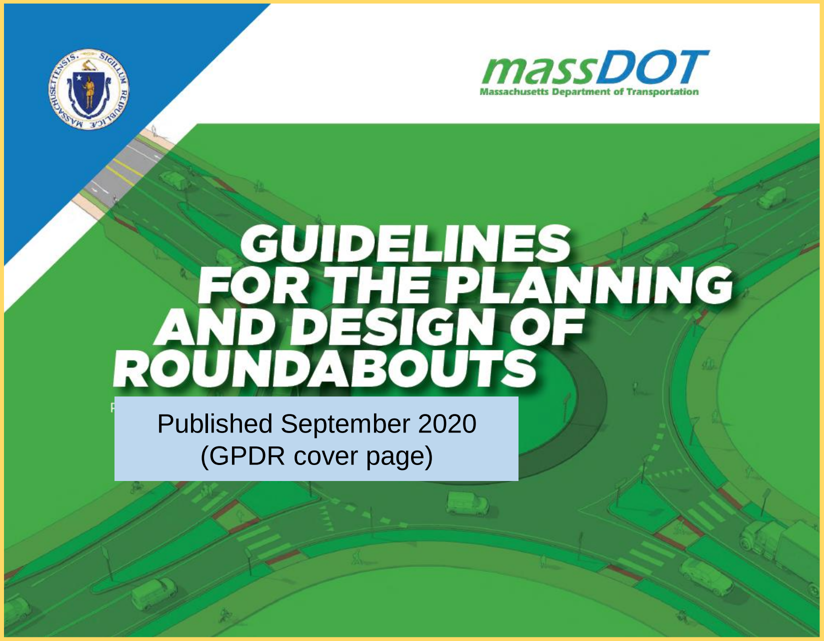
Circular intersection (link): More generally, a CI is an intersection that has an island, generally circular in design, located in the center of an intersection, where all vehicles pass to the right of the island

**✚ There are Alternate Roundabout Forms other than 'Round' Roundabouts (see right) ✚**
(**GPDR, p 60**)

FIGURE 5-33: KELLEY SQUARE, WORCESTER PEANUTABOUT DESIGN ILLUSTRATION


Figure Source: GPDR, p 62

- The GPDR incorporates & updates the 2011 FHWA roundabout guide (NCHRP Report 672);
- Integrates roundabout research & guidance that's occurred over the last 9 - 10 years;
- Includes improved pedestrian & bicycle guidance;
- Designed for Massachusetts & provides examples from within the state;
- Presents technical concepts in a graphical format to reach a wide audience;
- Provides procedures & methods of roundabout design that need to be coupled with sound engineering judgment to accomplish a design that best facilitates all users;
- Available online at: Roundabout Design




Published September 2020 (GPDR cover page)

Roundabout Basics

# Circular Intersections (CI): Roundabouts vs Large Diameter Rotaries

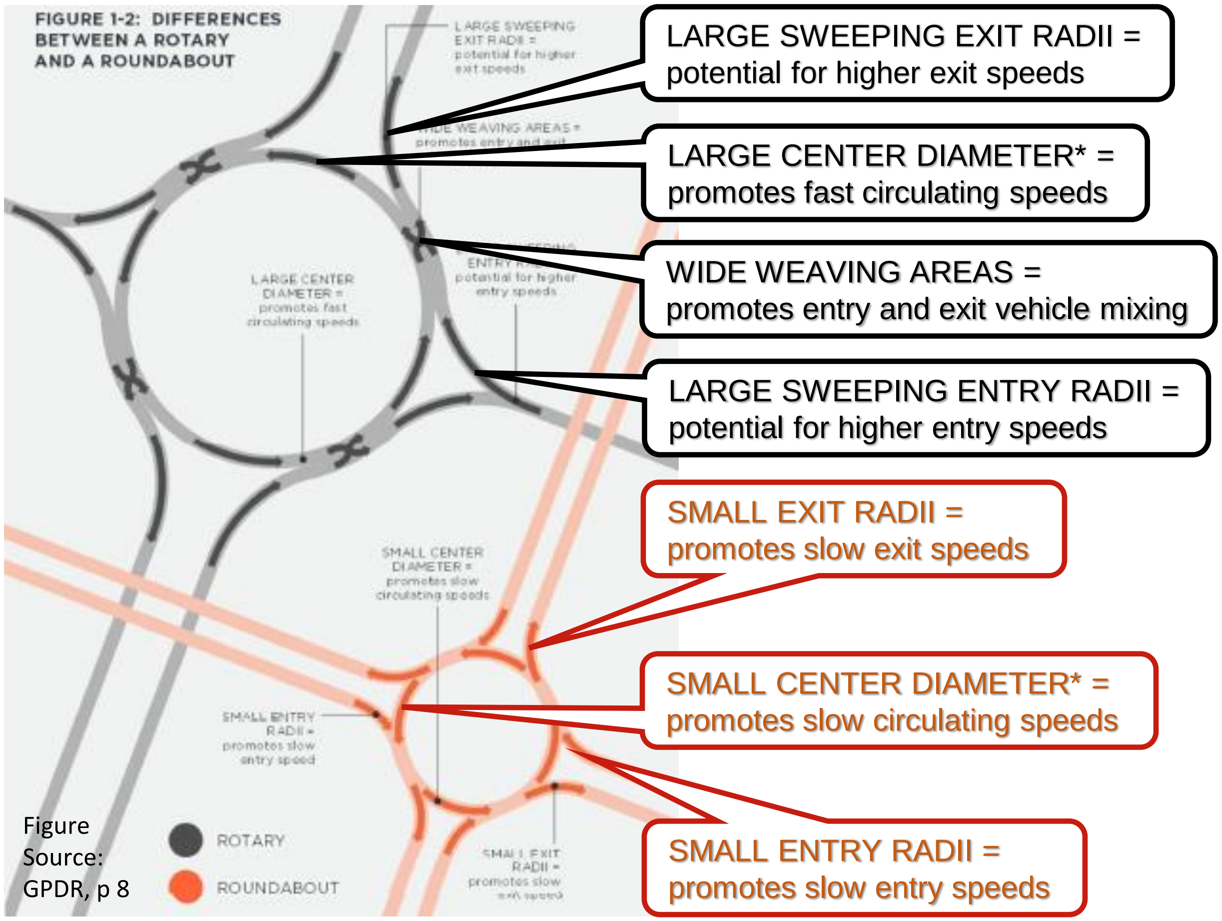



Figure Source: GPDR, p 8

*synonymous with Inscribed Circle Diameter

[Video: 10 Roundabout Myths]

Source: Minnesota Local Road Research Board

NOTE: See the GPDR for Massachusetts RA vs rotary comparison

**Both are Circular Intersections But are Designed Differently with Different Operational & Safety Characteristics**

## ROUNDABOUTS:

- Designed to promote slower vehicle entry speeds before a vehicle reaches the Yield Line
- Designed to promote slow circulating driving speeds within the circulatory roadway
- Narrow circulating lane (or lanes) constrict the area where a conflict or weaving may occur
- Feature Yield Lines & Signs on all approaches
- Vehicles approaching the roundabout must yield to the traffic in the roundabout to the left
- Right turn only is designated & assigned before a vehicle enters the roundabout that eliminates left turns & associated driver decision making
- 2-lane lane assignments are designated & assigned on all approaches before entering the circulatory roadway to avoid lane changing within the circulatory roadway

## LARGE DIAMETER ROTARIES:

*Note: Does not include rotary retrofit concepts developed by MassDOT. The concepts are discussed later in this report*

- Large circulating lane width & large center diameter creates vehicle weaving maneuvers between entries & exits
- Design may assume vehicles will accelerate at entries & exits. Entries may operate as highway ramps
- Lead vehicles conducting fast weaving maneuvers find it difficult to detect close following vehicles to the right
- Experience much higher entry & circulating speeds that creates the feel of a racetrack & results in high severity crashes when crashes occur

# Key Roundabout Features

**What Do Roundabouts Look Like?**
Link: Roundabouts Across the USA
(kittelson.com)

## *Include Bike & Accessible Pedestrian Design Features*

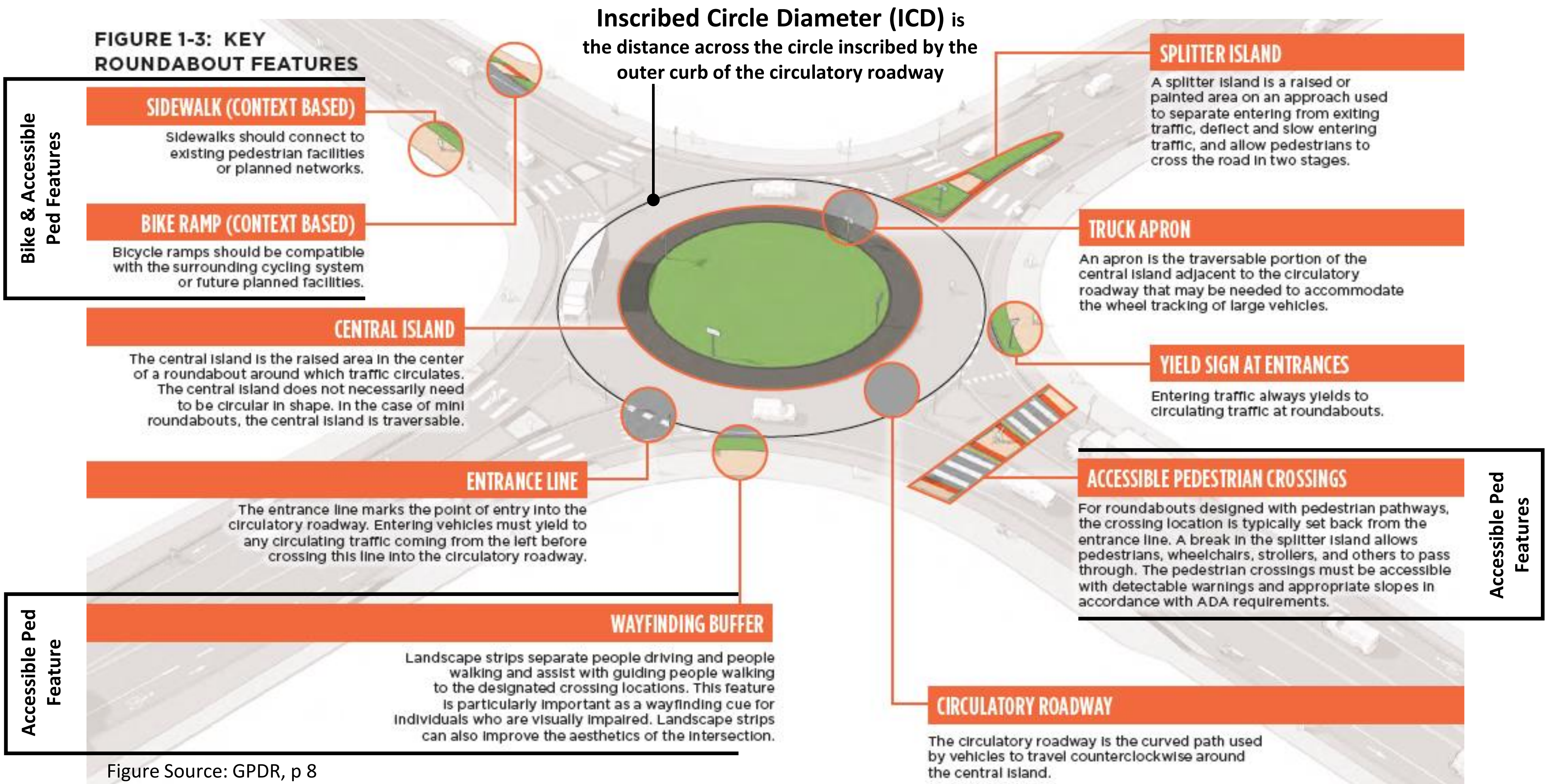



Figure Source: GPDR, p 8

# Roundabout Types & Design Elements

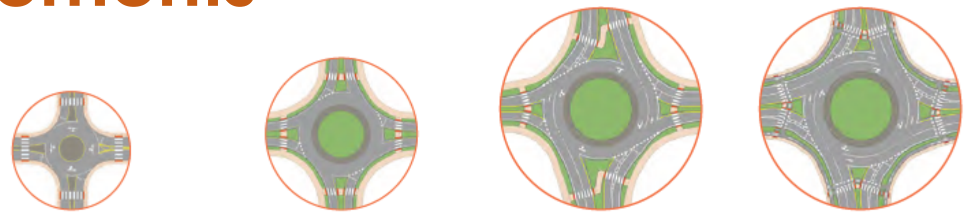


TABLE 1-1: TYPES OF ROUNDABOUTS

| DESIGN ELEMENT | MINI-ROUNDABOUT | SINGLE-LANE ROUNDABOUT | MIXED LANES ROUNDABOUT | MULTILANE ROUNDABOUT |
|---|---|---|---|---|
| Maximum number of circulating lanes | 1 | 1 | 2* | 2* |
| Typical inscribed circle diameter | 45 to 90 feet | 90 to 150 feet | 120 to 180 feet | 135 to 300 feet |
| Central island treatment | Traversable | Raised with traversable truck apron | Raised with traversable truck apron | Raised with traversable truck apron |
| Typical daily service volumes on four-leg roundabout | Up to approximately 15,000 | Up to approximately 25,000 | Up to approximately 35,000 for a two-lane road intersecting a four-lane road | Up to approximately 45,000 for a four-lane intersecting a four-lane road |
| Desirable entry speed range | 15 to 20 MPH | 20 to 25 MPH | 20 to 30 MPH | 25 to 30 MPH |

Table Source: GPDR, p 11

***Roundabouts can be designed with more than 2 circulating lanes but must be based on detailed traffic analysis that must be approved by MassDOT**

**SITE SPECIFIC CONDITIONS:** It is important to understand the site environment in which a roundabout is proposed.

**Key factors include:**

Constraints including right-of-way, utilities, structures, environmental issues, etc. that may impact the space available. Roundabouts often require more property at the corners of existing intersections; however, they can result in less widening of approach roadways than signalized intersections.

Roundabout location and user population: Is the intersection in a rural or urban environment? Will the roundabout have frequent pedestrian and/or bicycle activity? The roundabout design should support all intended modes of travel.

Issues that make it difficult for other types of traffic control (e.g., acute angles and challenging vertical profiles) can also be difficult with a roundabout.

Source: GPDR, p 21

# Roundabouts Reduce Intersection Conflict Points

## *(example: 4-way, Single-Lane Roundabout vs 4-way, 2-Lane Traditional Intersection)*

**Traditional intersections are intrinsically dangerous because they contain many conflict points for vehicle operators to consider when maneuvering through the intersection & conflicting traffic**

Roundabouts are a significantly ***SAFER intersection choice*** because they **eliminate most of the vehicular conflict points** that includes opposing traffic & pedestrian conflict points. Most of the reduction is the result of the ***ELIMINATION OF LEFT TURNS*** which also ***ELIMINATES*** many ***CONFLICT POINTS*** **for vehicle operators to consider when maneuvering through the intersection & conflicting traffic**

**After a roundabout is installed at a 4-way 2-lane intersection vehicular conflict points are reduced by 24 conflict points and pedestrian conflict points are reduced by 8 conflict points:**

2-lane Intersection with 4-approaches has:

- **32** vehicular conflict points &
- **16** vehicle to pedestrian conflict points

Single Lane Roundabout with 4-approaches has:

- **8** vehicular conflict points &
- **8** vehicle to pedestrian conflict points

***Intersection Vehicular & Pedestrian Conflict Points are locations in or on the approaches to a traditional intersection or roundabout where vehicle to vehicle or vehicle to pedestrian paths potentially collide***

FIGURE 1-5: POTENTIAL CONFLICT POINTS WITHIN AN INTERSECTION

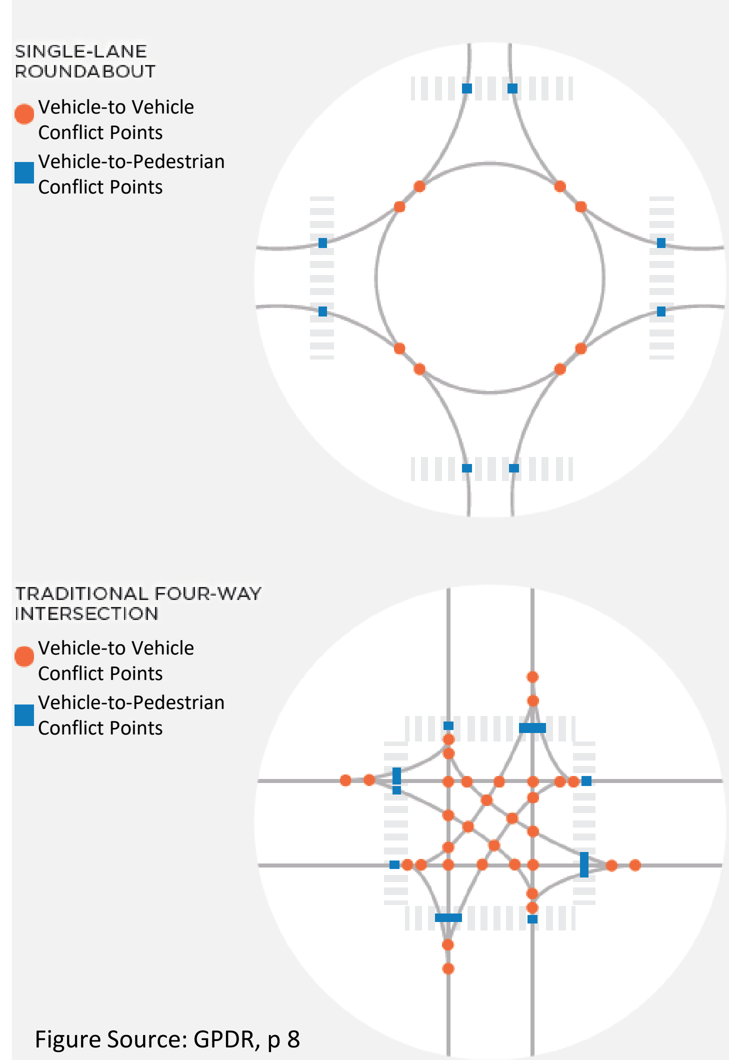



Figure Source: GPDR, p 8

# Roundabouts Result in Significant Improvements in Safety

**ROUNDABOUT CRASH REDUCTION VS TRADITIONAL INTERSECTION**

**IIHS and FHWA studies have shown that roundabouts improve safety when implemented at previously STOP controlled intersections. Roundabouts often achieve:**

- **90% reduction in Fatal Crashes;**
- **75% reduction in Injury Crashes;**
- **37% reduction in Total Crashes.**

**The improvements are the result of the design that REDUCES:**

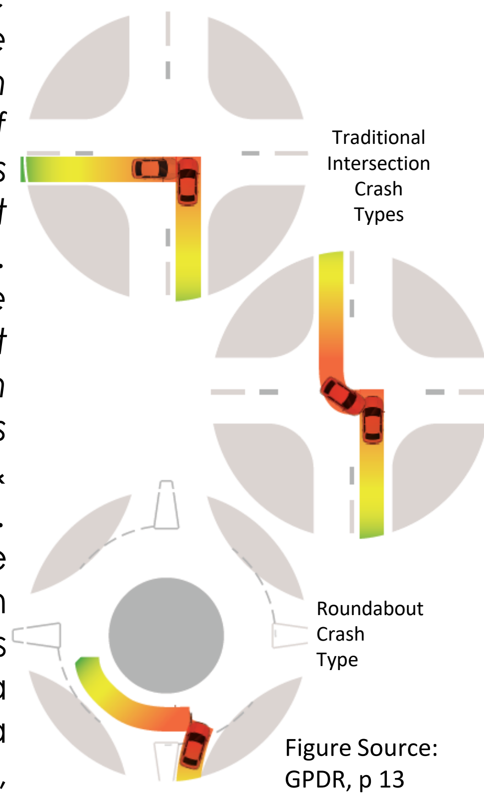
- **Conflict Points** (discussed on page 6)
- **Vehicle Speeds** (discussed on page 3)
- **Driver Decisions**
- **Conflict Severity**

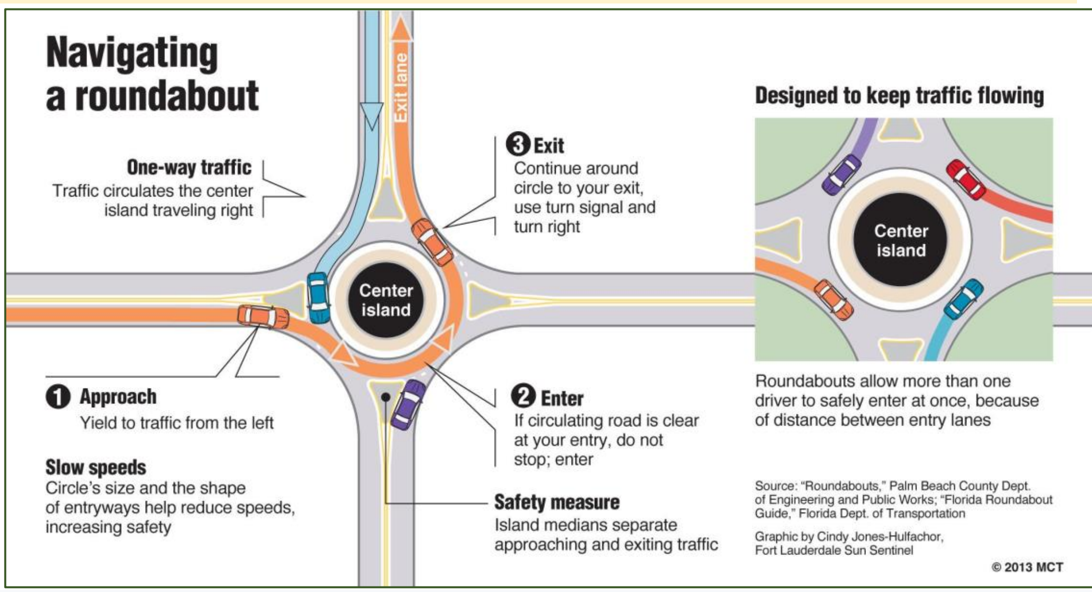
IIHS: Insurance Institute for Highway Safety
FHWA: Federal Highway Administration

***Reduced Conflict Severity:*** *RAs eliminate Head-on & most Angle Crashes which are high severity crash types. If an Angle Crash occurs at an RA, it will most likely be at a low angle. As the angle gets more acute which is what occurs at RAs, the crash types tend to be less severe rear-end & sideswipe crash types.* Pedestrians are more likely to survive a crash due to the lower speeds at an RA. When a pedestrian is hit by a vehicle going 25 mph, there's only a 5% chance they will die

**FIGURE 1-4: PRIMARY CRASH TYPE ALTERATION AT ROUNDABOUTS**

*Courtesy of Kittelson & Associates, Inc.*

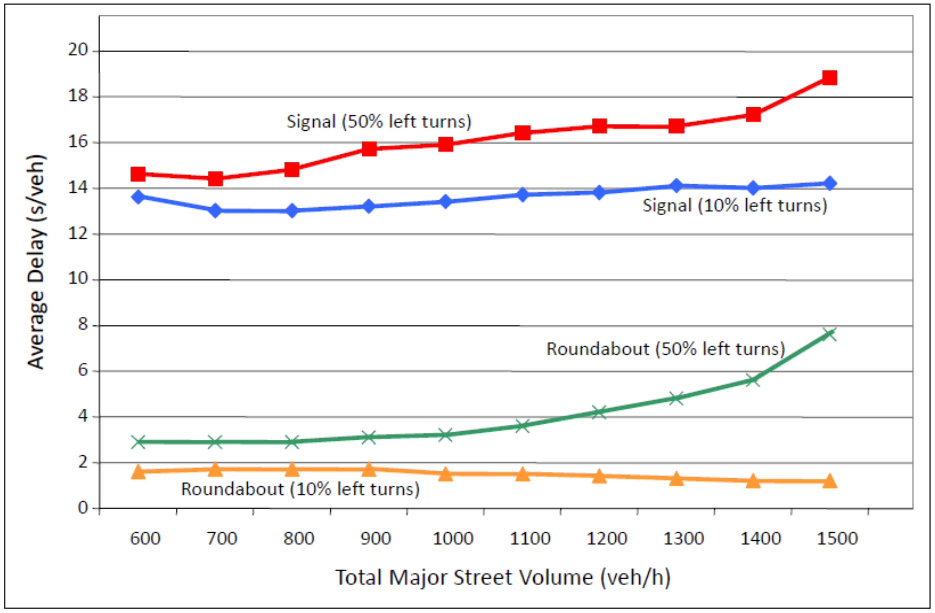



***Reduced Driver Decisions:*** *RAs are a series of deflected right-in & right-out movements where only one decision is made a time (decisions ❶ - ❸). A driver deals with one conflicting traffic stream at a time. This includes dealing with the pedestrian traffic stream (not shown in diagram). Pedestrian features are in most cases located at least a car length before the entry to the circulatory roadway. The slow and fairly uniform conflicting speeds compensate for driver error as vehicles have more time to stop*

# Roundabouts Can Produce Significant Improvements in Traffic Flow (1 of 3)

NCHRP Report 672, Exhibit 3-19




**Roundabout as a Traffic Flow Improvement:**

An RA may be considered as a traffic flow improvement alternative IF the estimated traffic flow is better than the existing, or estimated, traffic flow for alternate control modes such as STOP or Traffic Signalization. The relative performance of an RA proposal in comparison to other alternative control modes should be taken into consideration. Each RA should be justified on its own merits as the most appropriate intersection traffic flow improvement alternative. The following assumptions are based on documented analysis. An RA:

- Will always provide a higher capacity and lower delays than the All Way Stop Control mode operating with the same traffic volumes and right-of-way limitations;
- Is unlikely to offer better performance in terms of lower overall delays than Two Way Stop Control (TWSC) mode at intersections with minor movements that includes major street left turns that are not experiencing, nor predicted to experience, operational problems under TWSC;
- It may be assumed that a single-lane RA will operate within its capacity at any intersection that does not exceed the peak-hour volume of a signal warrant analysis;
- When it operates within its capacity the RA will generally produce lower delays than a signalized intersection operating with the same traffic volumes and right of way limitations.

**Traffic Signalization / Roundabout Comparison**:

The figure above provides a comparison that has been made when traffic volumes just meet the signal warrants analysis traffic volume thresholds for traffic signals. At the provided traffic volume levels, it can be estimated and anticipated that a single-lane RA will operate within its capacity when comparing RA delay to traffic signal delay. The figure shows average delays per vehicle for traffic signals (red & blue lines) and RAs (green & orange lines). The figure shows that RA control delays are substantially lower than traffic signal delays.

Sources: https://nacto.org/docs/usdg/nchrprpt672.pdf Page 3-30 and https://www.fhwa.dot.gov/publications/research/safety/00067/000673.pdf Page 62

# Roundabouts Can Produce Significant Improvements in Traffic Flow (2 of 3)

## (other documented analysis and sources)

**Reduce delay and improve traffic flow:**

Contrary to many peoples' perceptions, RAs actually move traffic through an intersection more quickly, and with less congestion on approaching roads. RAs promote a continuous flow of traffic. Unlike intersections with traffic signals, drivers don't have to wait for a green light at an RA to get through the intersection. Traffic is not required to stop – only yield – so the intersection can handle more traffic in the same amount of time.

Studies by Kansas State University measured traffic flow at intersections before and after conversion to RAs. In each case, installing an RA led to a 20% reduction in delays. Additional studies by the IIHS of intersections in three states, including Washington, found that RAs contributed to an 89% reduction in delays and 56% reduction in vehicle stops.

Source: https://wsdot.wa.gov/travel/traffic-safety-methods/roundabouts

**Efficient traffic flow**:

- 30-50% increase in traffic capacity;
- Improves traffic flow for intersections that handle a high number of left turns;
- Reduces need for turn lanes.

Source: https://www.in.gov/indot/traffic-operations/roundabouts/

# Roundabouts Can Produce Significant Improvements in Traffic Flow (3 of 3)

## (other documented analysis and sources)

**Traffic flow benefits:**

Several studies conducted by IIHS* and others have reported significant improvements in traffic flow following conversion of traditional intersections to RAs.

- A study of three intersections in Kansas, Maryland and Nevada where RAs replaced stop signs found that vehicle delays were reduced 13-23% and the proportion of vehicles that stopped was reduced 14-37% (Retting et al., 2002);
- A study of three locations in New Hampshire, New York and Washington state where RAs replaced traffic signals or stop signs found an 89% average reduction in vehicle delays and a 56% average reduction in vehicle stops (Retting et al., 2006);
- A study of 11 intersections in Kansas found a 65% average reduction in delays and a 52% average reduction in vehicle stops after RAs were installed (Russell et al., 2004);
- An Institute study of two-lane RA conversions at two intersections near Bellingham, Washington, found substantial declines in vehicle delays on the minor roads (33% and 90%) and the proportion of vehicles waiting in queues (35% and 43%) (Hu et al., 2014). Overall intersections delays increased (12% and 22%), due to slightly longer delays on the major approaches as vehicles slowed to enter the RAs.

Because RAs improve the efficiency of traffic flow, they also reduce vehicle emissions and fuel consumption.

Installing RAs in place of traffic signals or stop signs has been found to reduce carbon monoxide emissions by 15-45%, nitrous oxide emissions by 21-44%, carbon dioxide emissions by 23-34% and hydrocarbon emissions by 0-40% (Hu et al., 2014; Várhelyi, 2002).

Constructing RAs in place of traffic signals or stop signs reduced fuel consumption by an estimated 23-34% (Hu et al., 2014; Várhelyi, 2002; Höglund & Niittymäki, 1999).

Source: https://www.iihs.org/topics/roundabouts#traffic-flow-benefits

*Insurance Institute for Highway Safety

# MRPC Region CIs:
# Large Diameter Rotaries (LDR), Small Diameter Rotaries (SDR), & Roundabouts

| Table 1 | Mini RA* | Single-Lane RA* | Small Diameter Rotary** | Mixed-Lane RA* | Multiple-Lane RA* | Large Diameter Rotary** |
|---|---|---|---|---|---|---|
| Max # Lanes | 1 | 1 | 1 | 2 | 2 | 1 |
| Typical ICD (feet) | 45 - 90 | 90 - 150 | 90 - 220^ | 120 - 180 | 135 - 300 | 418 - 470 |
| Typical Daily Service Volumes (TDSV) (approximate) | 15,000 | 25,000 | NP | 35,000 | 45,000 | NP |

*Source: Table 1-1, GPDR p 11
**Source: ICD range of LDRs & SDRs in the MRPC Region
^refers to oblong ICD & large paved areas of SDRs

- **Table 1** combines the RA ICD ranges found on page 6 with the ICD ranges of the LDRs and SDRs found in the MRPC Region;
- Only Single-Lane and Mini RAs exist in the MRPC Region;
- SDRs are either oblong in shape and/or are located in large paved areas;
- SDR and LDR TDSVs are not provided (NP)

- **Table 2** provides CI totals by community, and by LDR / SDR, & RA. The table includes planned & proposed RAs;
- A grand total of 16 CIs exist in the MRPC Region of which five (31%) are LDR / SDRs and 11 (69%) are RAs;
- Fitchburg and Sterling each have three RAs (27.3% share each);
- Five communities with one RA: Ashby, Athol, Gardner (to be converted from SDR), Lancaster, Templeton;
- Three communities with one LDR / SDR: Ayer, Fitchburg, Lunenburg;
- One community with two LDR / SDRs: Gardner

| Table 2 | LDR & SDR Count | Percent of LDR & SDR TOTAL | RA Count* | Percent of RA TOTAL | Grand Total (GT) |
|---|---|---|---|---|---|
| Ashby | | 0% | 1 | 9.1% | |
| Athol | | 0% | 1 | 9.1% | |
| Ayer | 1 | 20% | | 0% | |
| Fitchburg | 1 | 20% | 3 | 27.3% | |
| Gardner | 2 | 40% | 1 | 9.1% | |
| Lancaster | | 0% | 1 | 9.1% | |
| Lunenburg | 1 | 20% | | 0% | |
| Sterling | | 0% | 3 | 27.3% | |
| Templeton | | 0% | 1 | 9.1% | |
| **Totals/% of GT** | **5** | **31%** | **11** | **69%** | **16** |

*includes Planned & Proposed RAs

CIs in the MRPC Region

# Further Breakdown of CIs: By Type (LDR / SDR / RA); by Community & by Project Development Status (PDS)

^A retrofitted LDR would be based on the MassDOT ***Rotary Retrofits White Paper***. LDRs can benefit from the introduction of RA design elements by following the principles listed in Section 5 of the GPDR and by eliminating elements not found at RAs. See ***LDR Retrofit: Rt 2 at Rt 68 (Timpany Blvd), Gardner*** below for more info.

| **Table 3** | **LDRs** | | | | |
|---|---|---|---|---|---|
| | **LDR** | **Retrofitted LDR^ (adds RA elements)** | **Planned Retrofit** | **Proposed Retrofit** | **SDRs** |
| Ayer | + | | NO | NO | |
| Fitchburg | | | | | + |
| Gardner | + | + | | | + (See RA Table 4) |
| Lunenburg | | | | | + |
| **Totals** | **2** | **1** | | | **2** |
| **PERCENT of GT** | **12.5%** | **6.3%** | | | **12.5%** |

= 1 LDR or SDR or Retrofitted LDR

= 1 RA

= 2 RAs

+ See RA Table 4

- **Table 3** provides LDR and SDR information by community and PDS;
- Of the two Gardner LDRs, a retrofit project at one LDR has been completed but no retrofit project is underway for the second Gardner LDR and no retrofit project is underway for the Ayer LDR;
- Three communities with one SDR: Fitchburg, Gardner, Lunenburg. See Table 4 for more info on the Gardner SDR

| **Table 4** | **RAs** | | | | |
|---|---|---|---|---|---|
| | **SDR Planned Conversion to RA** | **Built RA** | **Built Mini RA** | **Planned RA** | **Proposed RA** |
| Ashby | | | | + | |
| Athol | | + | | | |
| Fitchburg | | + | + (2 RAs) | | |
| Gardner | + | | | | |
| Lancaster | | + | | | |
| Lunenburg | | | | | |
| Sterling | | + (2 RAs) | | | + |
| Templeton | | | | + | |
| **Totals** | **1** | **5** | **2** | **2** | **1** |
| **PERCENT of GT** | **6.3%** | **31.3%** | **12.5%** | **12.5%** | **6.3%** |

- **Table 4** provides RA information by community and PDS;
- Gardner SDR will be converted to an RA;
- Four communities have built RAs: Athol, Fitchburg, Lancaster, two RAs have been built in Sterling;
- Two mini RAs have been built in Fitchburg;
- Two RAs are being planned for the communities of Ashby and Templeton;
- One additional RA has been proposed for Sterling

# LDR & SDR Locations

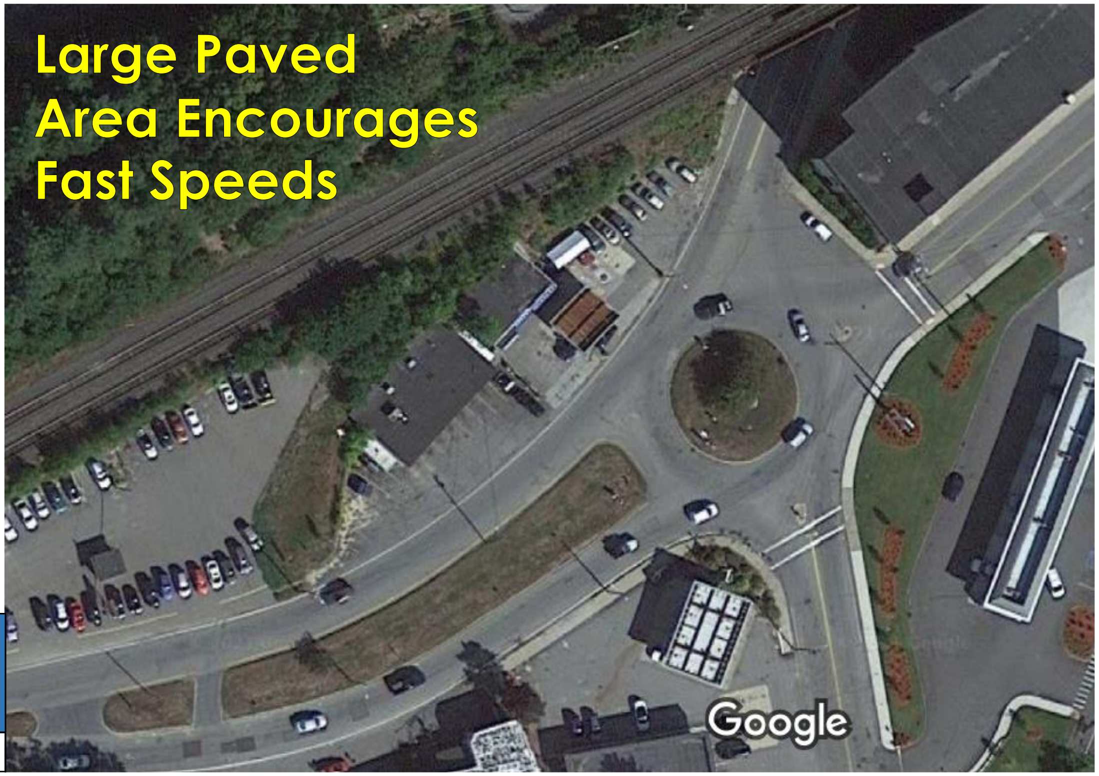
| MRPC Member Communities | Rotary Type LDR / SDR | LDR / SDR Locations | Known As |
|---|---|---|---|
| AYER | LDR | Routes 2A/110/111 | Carlton Circle |
| FITCHBURG | SDR | Rts 2A/12/31 (River St) & Rts 2A/12 (Kimble St) at Rt 31 (River St) & Daniels St | |
| GARDNER | LDR (Rotary Retrofit) | Rt 2 at Rt 68 (Timpany Blvd) | |
| GARDNER | LDR | VFW Circle, Rt 2 at Pearson Blvd | VFW Circle |
| GARDNER | SDR* | Rt 101 (Central/Pearl St) at Elm/Pearl Sts | |
| LUNENBURG | SDR | Whalom Rd/Pond St at Prospect St/Carr Ave/Lake Front Ave | |

*tempory SDR status, see RAs below for more

# LDR: Routes 2A/110/111 (Carlton Circle), Ayer

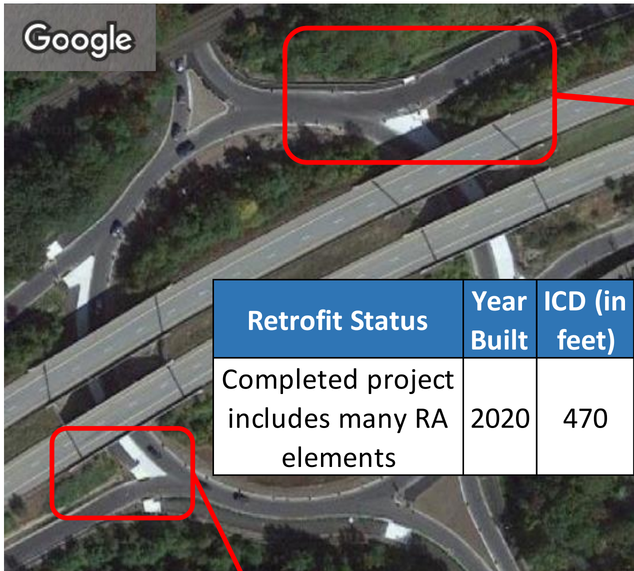

| Retrofit Status | Year Built | ICD (in feet) | Comment |
|---|---|---|---|
| NA | NA | 418 | six approaches to LDR |

# SDR: Rts 2A/12/31 (River St) & Rts 2A/12 (Kimble St) at Rt 31 (River St) & Daniels St, Fitchburg

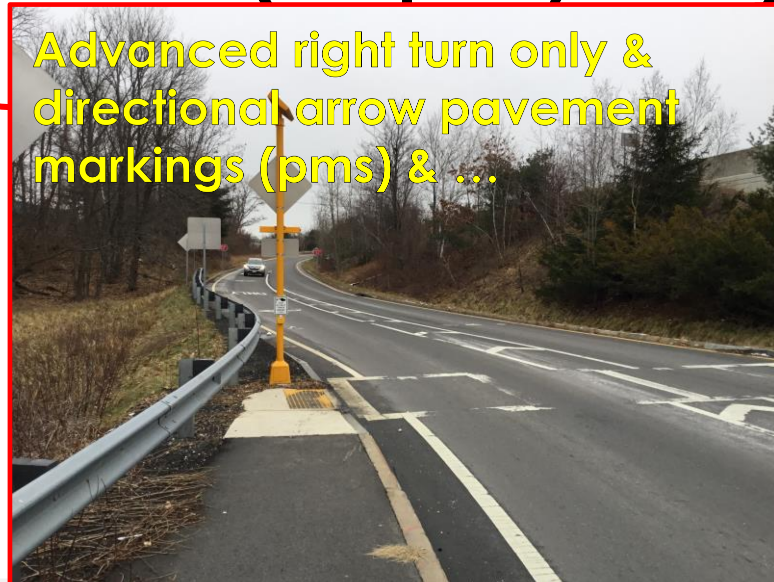



| RA Conversion Status | Year Built | ICD (in feet) | Comment |
|---|---|---|---|
| NA | NA | 130 - 193 | large paved area |

# LDR Retrofit: Rt 2 at Rt 68 (Timpany Blvd), Gardner

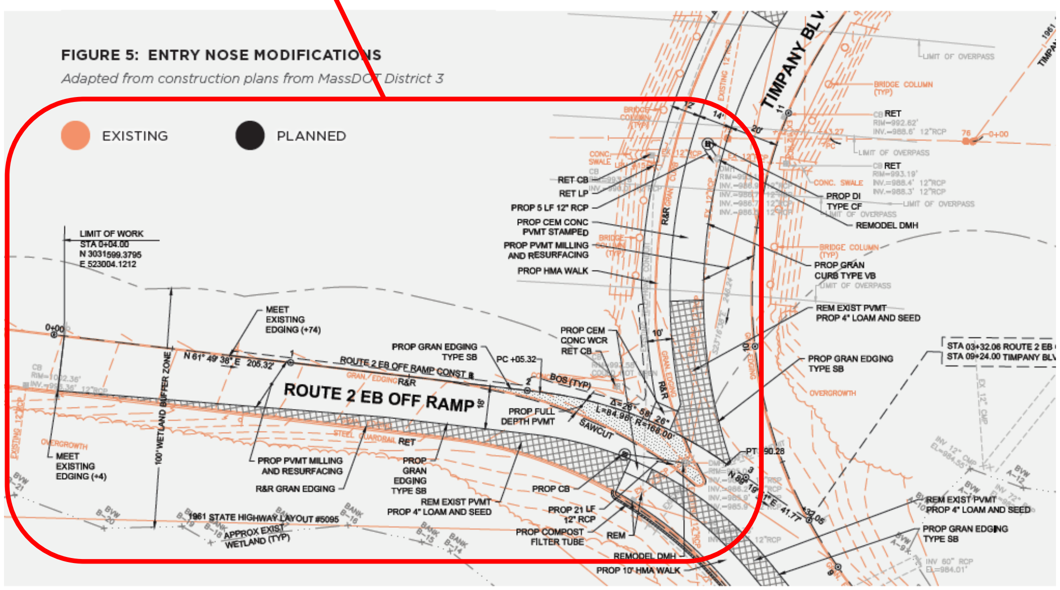



| Retrofit Status | Year Built | ICD (in feet) |
|---|---|---|
| Completed project includes many RA elements | 2020 | 470 |






**ENTRY MODIFICATIONS**: The figure below shows a portion of the construction plan that adjusted the entry geometry from the Rt 2 EB off-ramp into the Rt 68 rotary in Gardner. The original entry nose geometry led vehicles nearly parallel with the circulatory lanes.
The completed nose geometry is aligned with the inside curb around the circulatory roadway, leading vehicles into the circulating lane, and deflects their path to promote slower entry speeds.





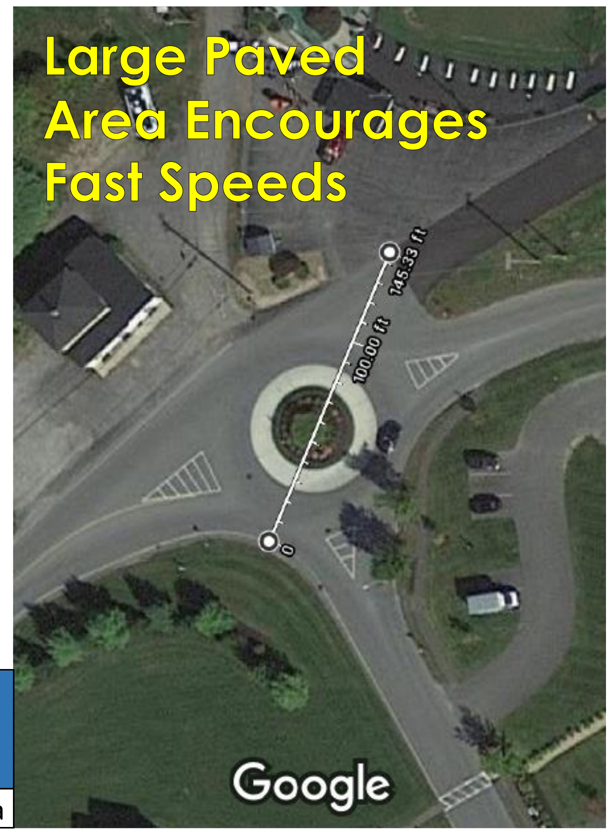
Available online at:

[MassDOT Rotary Retrofits White Paper]

# LDR: VFW Circle, Rt 2 at Pearson Blvd, Gardner


| Retrofit Status | Year Built | ICD (in feet) | Comment |
|---|---|---|---|
| NA | NA | 470 | girders & abutments limit sight distance at the Rt 2 off ramps for vehicles on the ramps and on the circular lane |

# SDR: Whalom Rd/Pond St at Prospect St/Lakefront Ave, Lunenburg

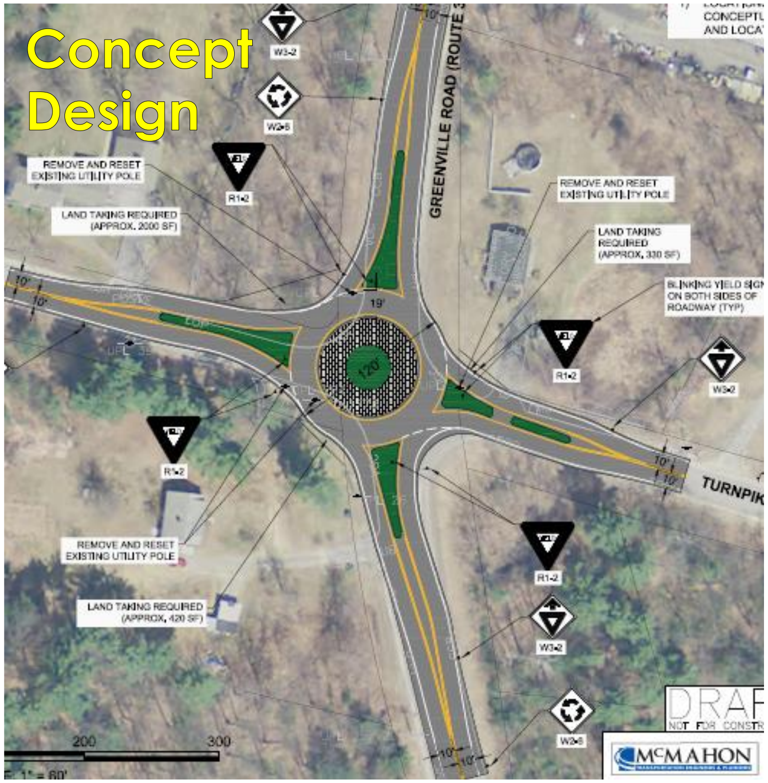



| RA Conversion Status | Year Built | ICD (in feet) | Comment |
|---|---|---|---|
| NA | NA | 102 - 145 (see line) | large paved area |

# RA Locations

| MRPC Member Communities | RA Type | RA Location |
|---|---|---|
| ASHBY | RA (planned) | Rt 31 (Greenville Rd) at Turnpike Rd |
| ATHOL | RA (privately owned) | Reservoir Rd at Market Dr (RA within a commercial development) |
| FITCHBURG | Mini RA | Rt 31 (Main/River Sts) at Main St |
| FITCHBURG | RA | Rt 31 (Mechanic St/Ashby State Rd) at John Fitch Hwy/Rindge Rd |
| FITCHBURG | Mini RA | Electric Ave at Rollstone Rd |
| GARDNER | SDR (RA planned) | Rt 101 (Central/Pearl St) at Elm/Pearl Sts |
| LANCASTER | RA | Rt 70 (Lunenburg Rd) at Old Union Tpk |
| STERLING | RA | Rt I190 SB Ramps at Rt 12 (Leominster Rd) |
| STERLING | RA | Rt 12 (Leominster Rd) at Chocksett Rd |
| STERLING | RA (proposed per study recommendation) | Rt 140 (Redemption Rock Tr) at Rt 62 (Princeton Rd) |
| TEMPLETON | RA (planned) | Patriots Rd (Rts 2A & 101) at Rt 101 (Gardner Rd) & N Main St |

# Planned Single Lane RA: Rt 31 (Greenville Rd) at Turnpike Rd, Ashby

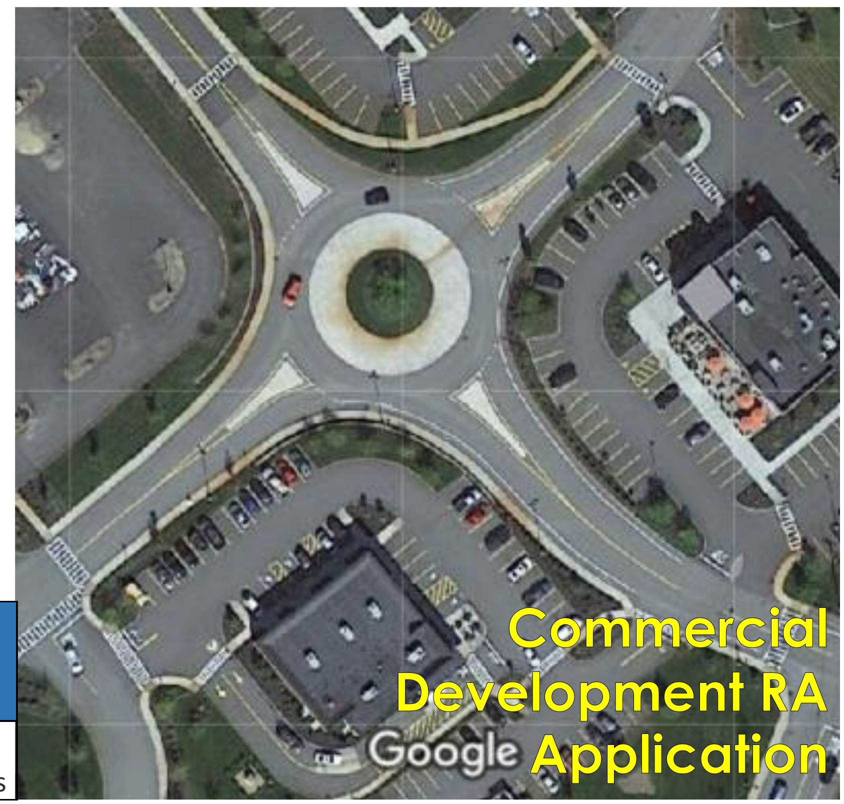



| RA Status | TIP Year | ICD (in feet) | Estimated Total Project Cost | Comment |
|---|---|---|---|---|
| In Design | 2022 | 120 | $2,082,000 | safety improvement |

**Link to 25% Design Drawings & other Info**

[Ashby - Design Public Hearing webinar]

# Reservoir Rd at Market Dr, N Quabbin Commons, Athol



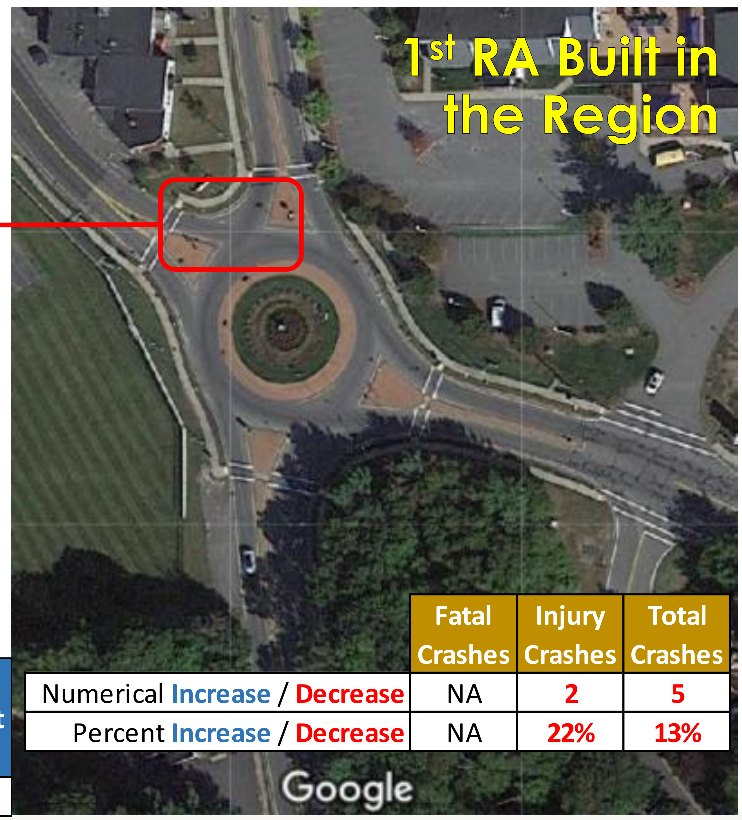

| RA Status | Year | ICD (in feet) | Estimated Total Project Cost | Comment |
|---|---|---|---|---|
| Built | 2014 | 130 | NP | crosswalks located outside of splitter islands |

# Mini RA: Rt 31 (Main/River Sts) at Main St, Fitchburg


| RA Status | Year | ICD (in feet) | Estimated Total Project Cost | Comment |
|---|---|---|---|---|
| Built (city) | 2017 | 53 | NP | could see revisions |

# Rt 31(Ashby State Rd/ Mechanic St) at John Fitch Hwy/Rindge Rd, Fitchburg

46% of the post construction total crashes involved vehicles in the circular roadway at the skewed Rindge Road Westbound and the Ashby State Road Southbound approaches. These crashes may be the result of the proximity of the approaches

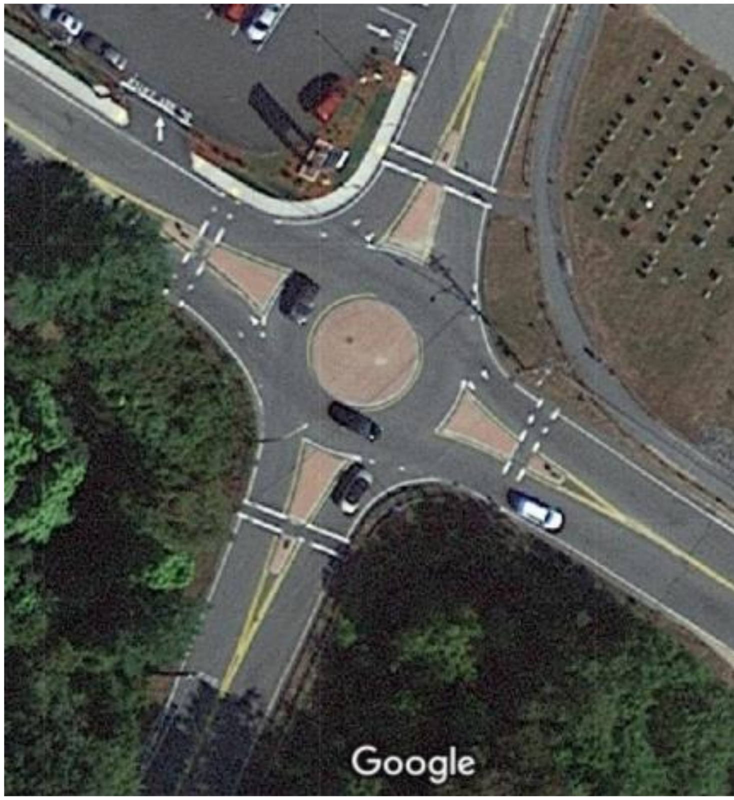



| | Fatal Crashes | Injury Crashes | Total Crashes |
|---|---|---|---|
| Numerical Increase / Decrease | NA | 2 | 5 |
| Percent Increase / Decrease | NA | 22% | 13% |

| RA Status | Year | ICD (in feet) | Estimated Total Project Cost |
|---|---|---|---|
| Built | 2011 | 130 | $1,224,400 |

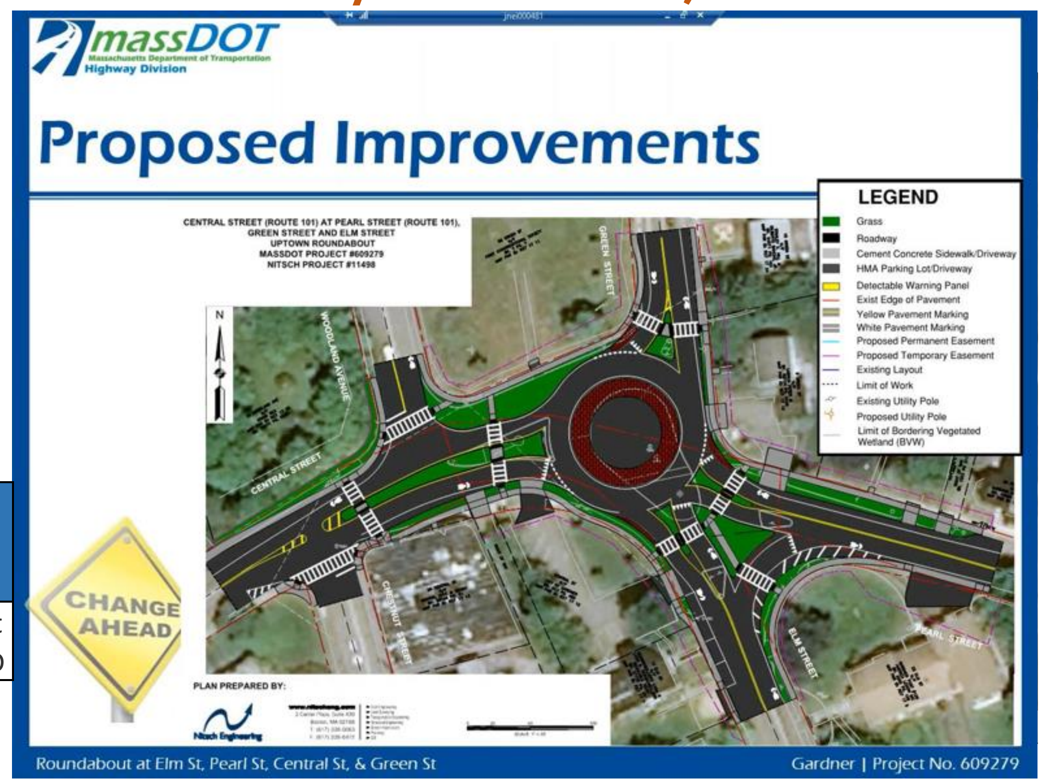
**CITIZENS OF ASHBY FAMILIARITY WITH RA TRAFFIC FLOW IMPROVEMENT AT THIS RA PAVED THE WAY FOR THE ASHBY RA** (previous page) **TO BE ACCEPTED BY COMMUNITY**

# Mini RA: Electric Ave at Rollstone Rd, Fitchburg




| RA Status | Year | ICD (in feet) | Estimated Total Project Cost | Comment |
|---|---|---|---|---|
| Built (city) | 2017 | 70 | $230,000 | needs accessible pedestrian facilities |

# Planned Single Lane RA at SDR: Rt 101 (Central/Pearl Sts) at Elm/Pearl Sts, Gardner

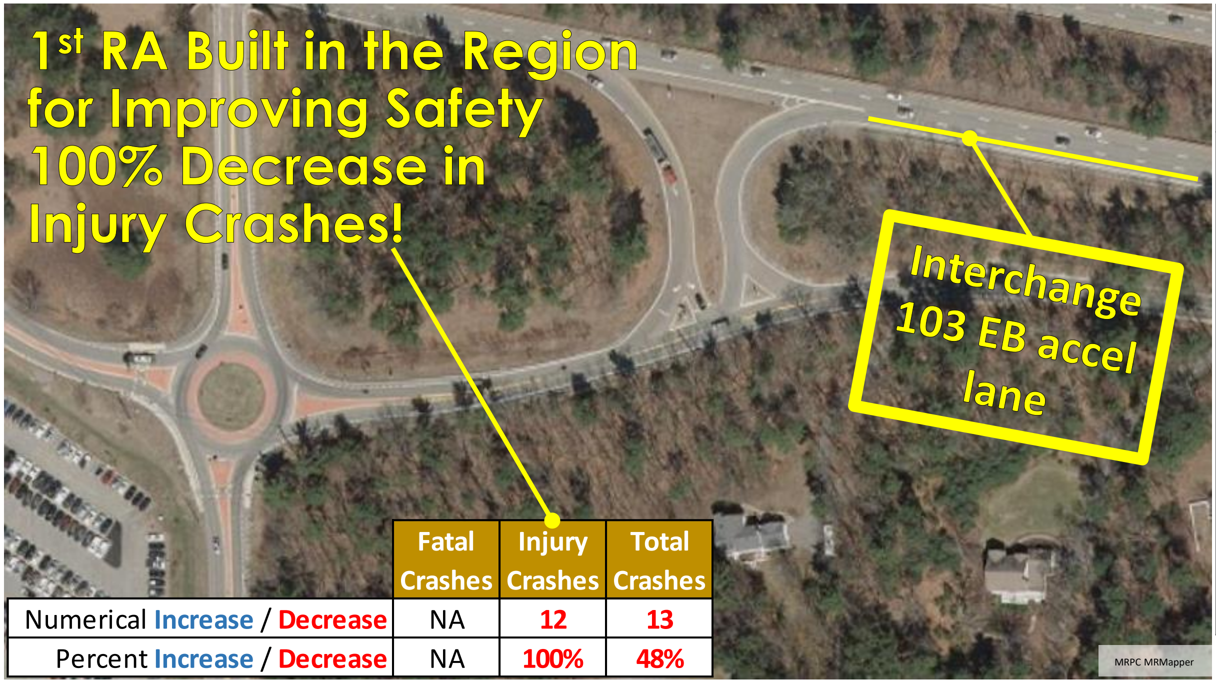



| RA Status | TIP Year | ICD (in feet) | Estimated Total Project Cost | Comment |
|---|---|---|---|---|
| In Design | 2025 | 90 - 219* | $2,077,200 | safety improvement *existing oblong ICD |

**Link to 25% Design Drawings & other Info**

[Gardner - Design Public Hearing webinar]

# Rt 70 (Lunenburg Rd) at Old Union Turnpike, Lancaster




| | Fatal Crashes | Injury Crashes | Total Crashes |
|---|---|---|---|
| Numerical Increase / Decrease | NA | 12 | 13 |
| Percent Increase / Decrease | NA | 100% | 48% |

| RA Status | Year | ICD (in feet) | Estimated Total Project Cost | Comment |
|---|---|---|---|---|
| Built | 2013 | 125 | $1,800,000 | safety improvement project that also included raising the intersection vertical profile approximately 2', lengthening Rt 2 Interchange 103 eastbound acceleration lane approximately 1,000' and changing ramp control from STOP to YIELD. |

**New Project may be Needed**:

Based on the following project developments that, if built, will add traffic volume to the RA in the future

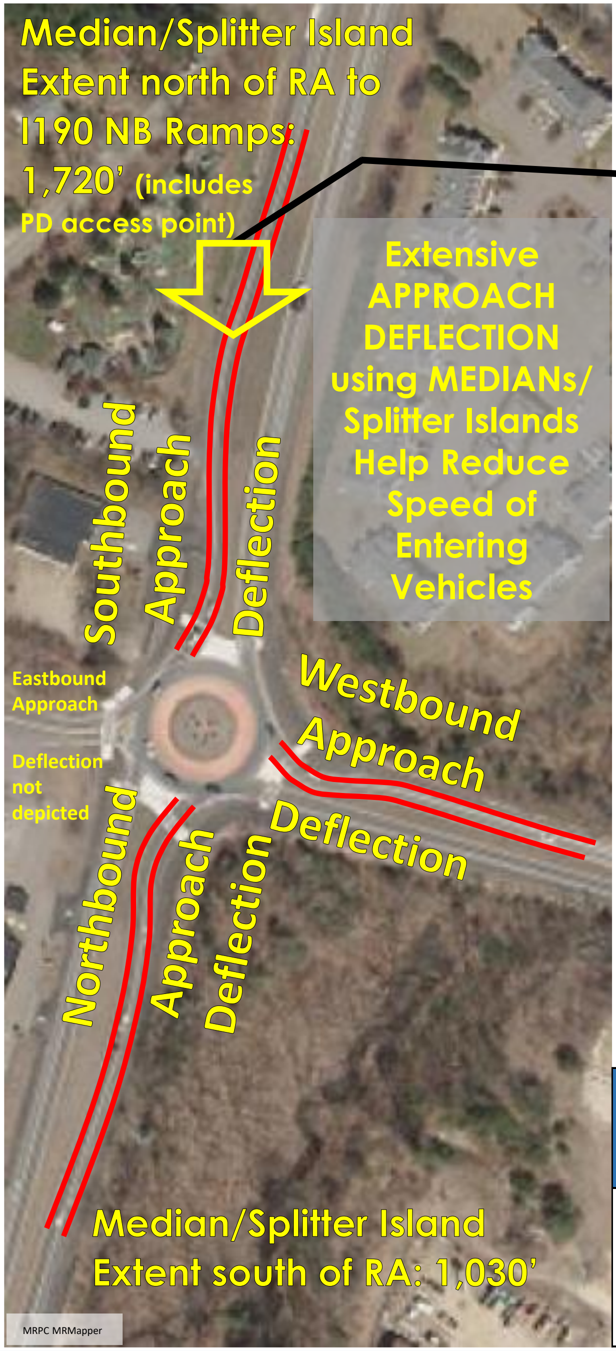
- The Landing: a 2,186,190 sq ft of mixed development on Route 70 at McGovern Boulevard in Lancaster
  Link: Capital Group Information
- Unified Global Packaging located at 580 Fort Pond Road in Lancaster will be adding 272,000 sq ft to the existing building;
- The construction of a new 372,000 sq ft warehouse and distribution center at 1263 Reservoir/435 Leominster Shirley Road in Lunenburg;
- Also, MassDOT is developing ramp realignment and relocation of the acceleration and deceleration lanes projects of Exits 102, 103, and 104 in Lancaster that will alter the existing traffic flow of the roundabout

# 1st RA Built at Interchange Ramps in the Region: Rt I190 SB Ramps at Rt 12 (Leominster Rd), Sterling



| RA Status | Year | ICD (in feet) | Estimated Total Project Cost | Comment |
|---|---|---|---|---|
| Built | 2018 | 143 | NA | project also included RA at Rt 12 (Leominster Rd) at Chocksett Rd total project length: 1.5 miles |

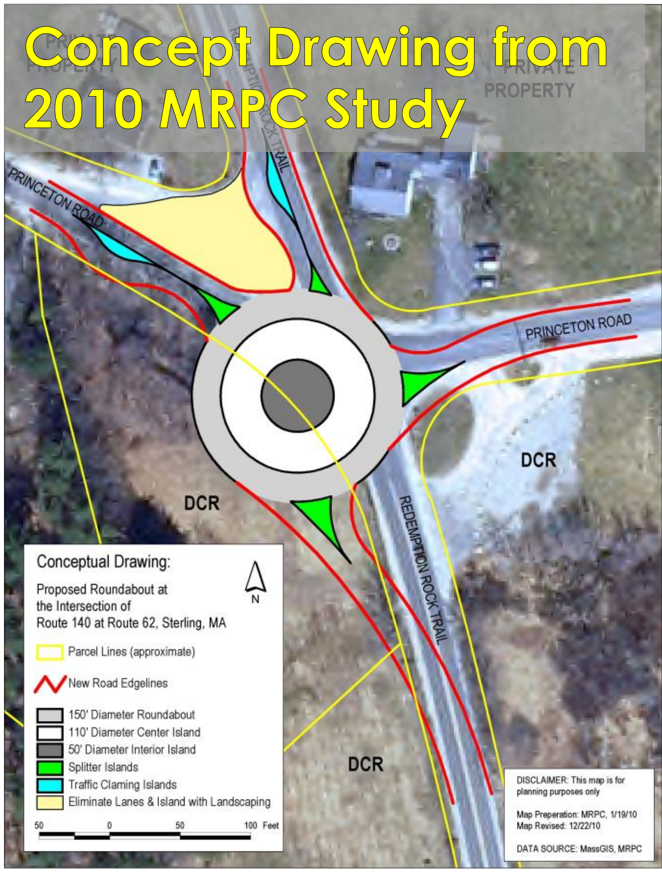
# Rt 12 (Leominster Rd) at Chocksett Rd, Sterling





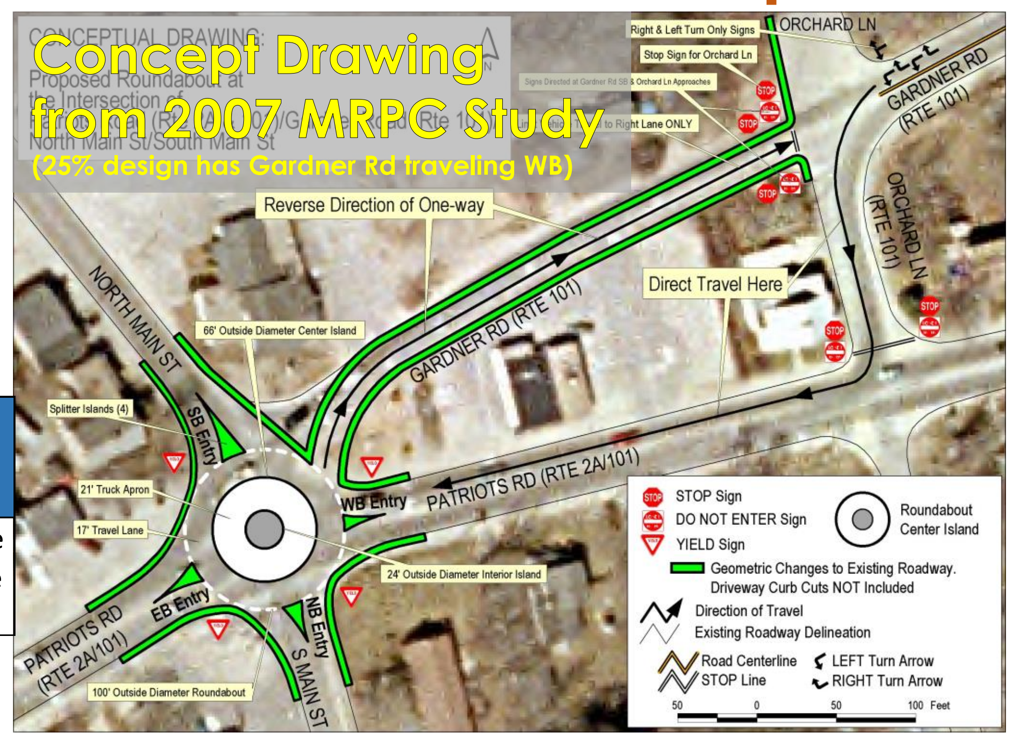
| RA Status | Year | ICD (in feet) | Estimated Total Project Cost | Comment |
|---|---|---|---|---|
| Built | 2018 | 143 | NA | safety improvement. Project also included RA at Rt I190 SB Ramps at Rt 12 (Leominster Rd) total project length: 1.5 miles |

# Preferred Alternative Single Lane RA: Rt 140 (Redemption Rock Tr) at Rt 62 (Princeton Rd), Sterling




| RA Status | TIP Year | ICD (in feet) | Estimated Total Project Cost | Comment |
|---|---|---|---|---|
| Concept | NA | 150 | NA | community prefered operational & safety improvement alternative |

# Planned Single Lane RA: Patriots Rd (Rts 2A & 101) at Rt 101 (Gardner Rd) & N Main St, Templeton




| RA Status | TIP Year | ICD (in feet) | Estimated Total Project Cost | Comment |
|---|---|---|---|---|
| In Design | 2023 | 150* | $1,867,000 | five approach RA with one approach at skewed angle *from MRPC 2010 study |

Link to 25% Design Drawings & other Info

[Templeton - Design Public Hearing webinar](Templeton - Design Public Hearing webinar)