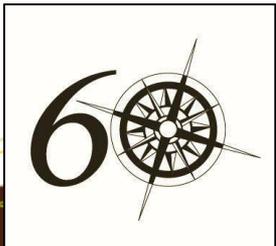


Roundabouts

By: Nezamuddin,
Valparaiso University

February 19, 2015



Northwestern Engineering

Northwestern University Transportation Center

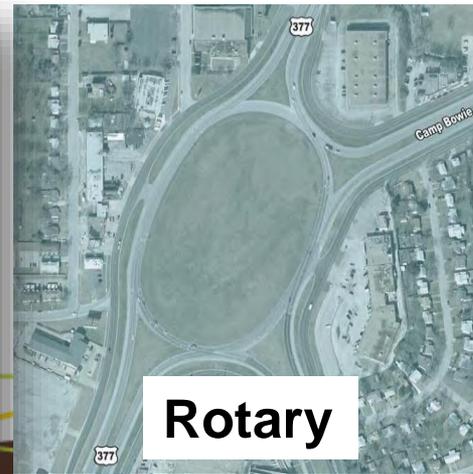
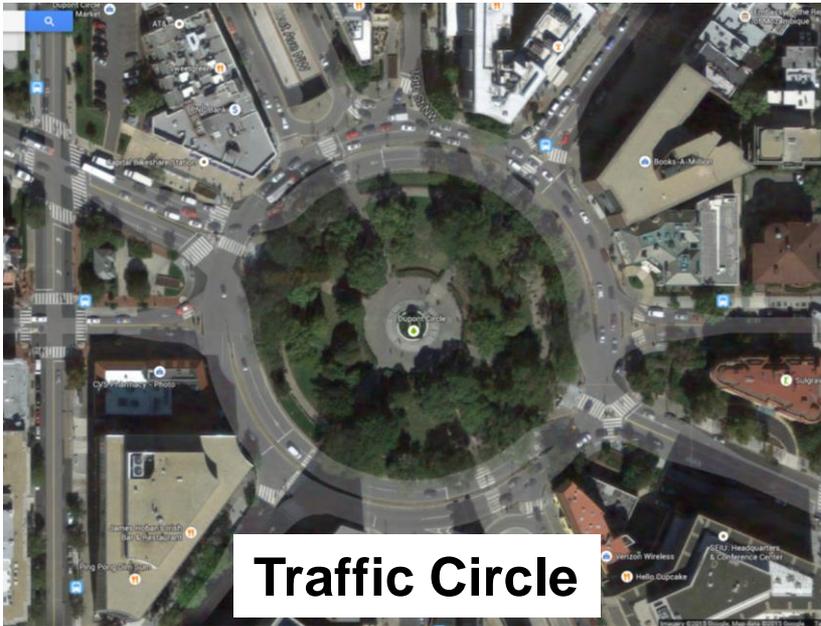


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Outline

1. Background on Roundabouts
2. Silhavy Rd. Corridor Improvement Project in Valparaiso, IN
3. 5-points Roundabout in Valparaiso, IN

Circular Junctions



(Sources: Bing maps, FHWA)

Columbus Circle, NY (Built in 1905)



Early 20th Century Circular Junctions

- Designed for high-speed entry
- Entering vehicles had priority over circulating vehicles
- Result: high **crash** rate and **choked** traffic circles
- **Unpopular** in the US.
- United Kingdom (1960s): mandatory “yield-at-entry” rule at circular junctions => **modern roundabouts**



Modern Roundabout – Key Features



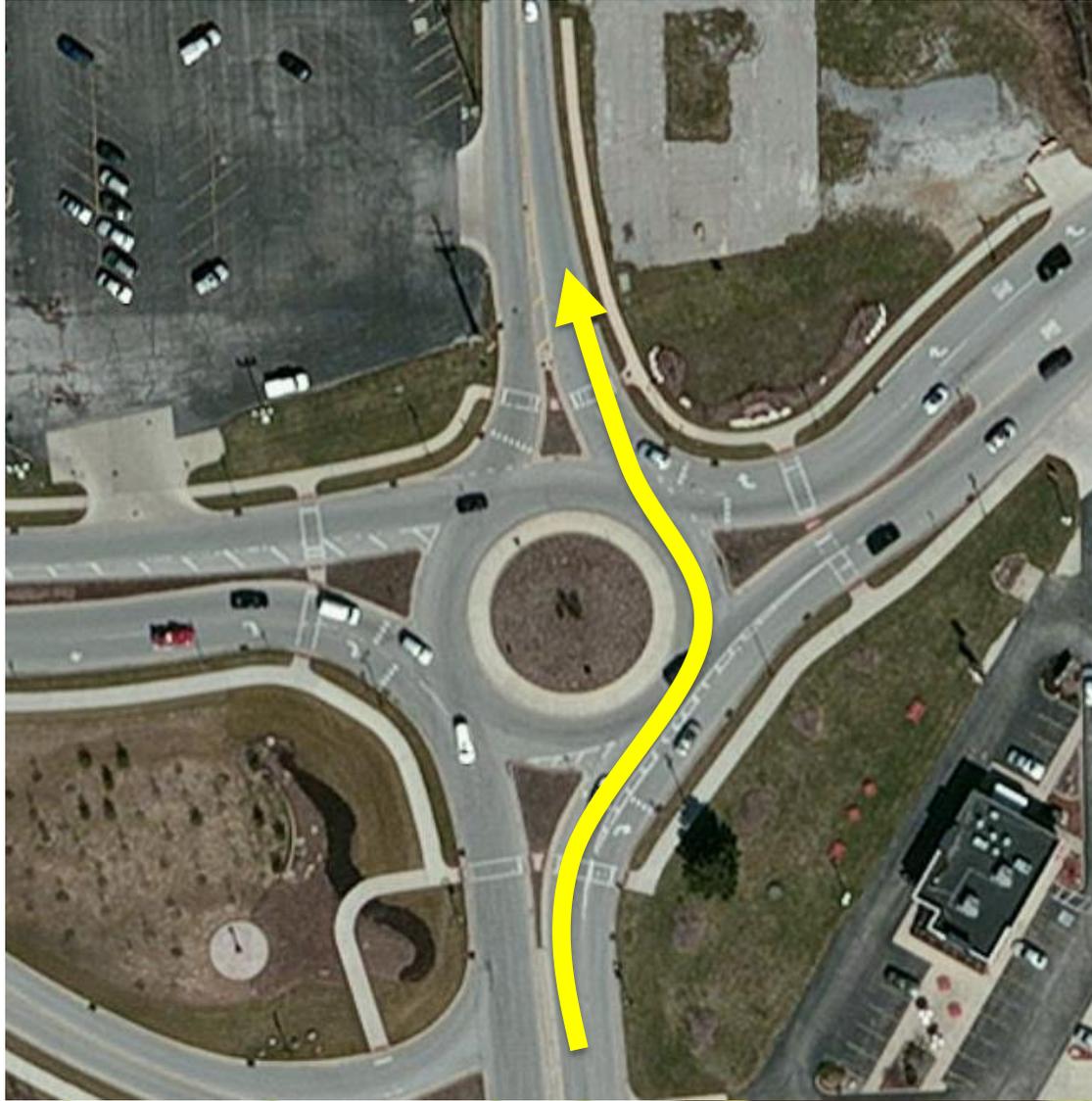
Yield control

(Source: Bing maps)



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Modern Roundabout – Key Features



Yield control

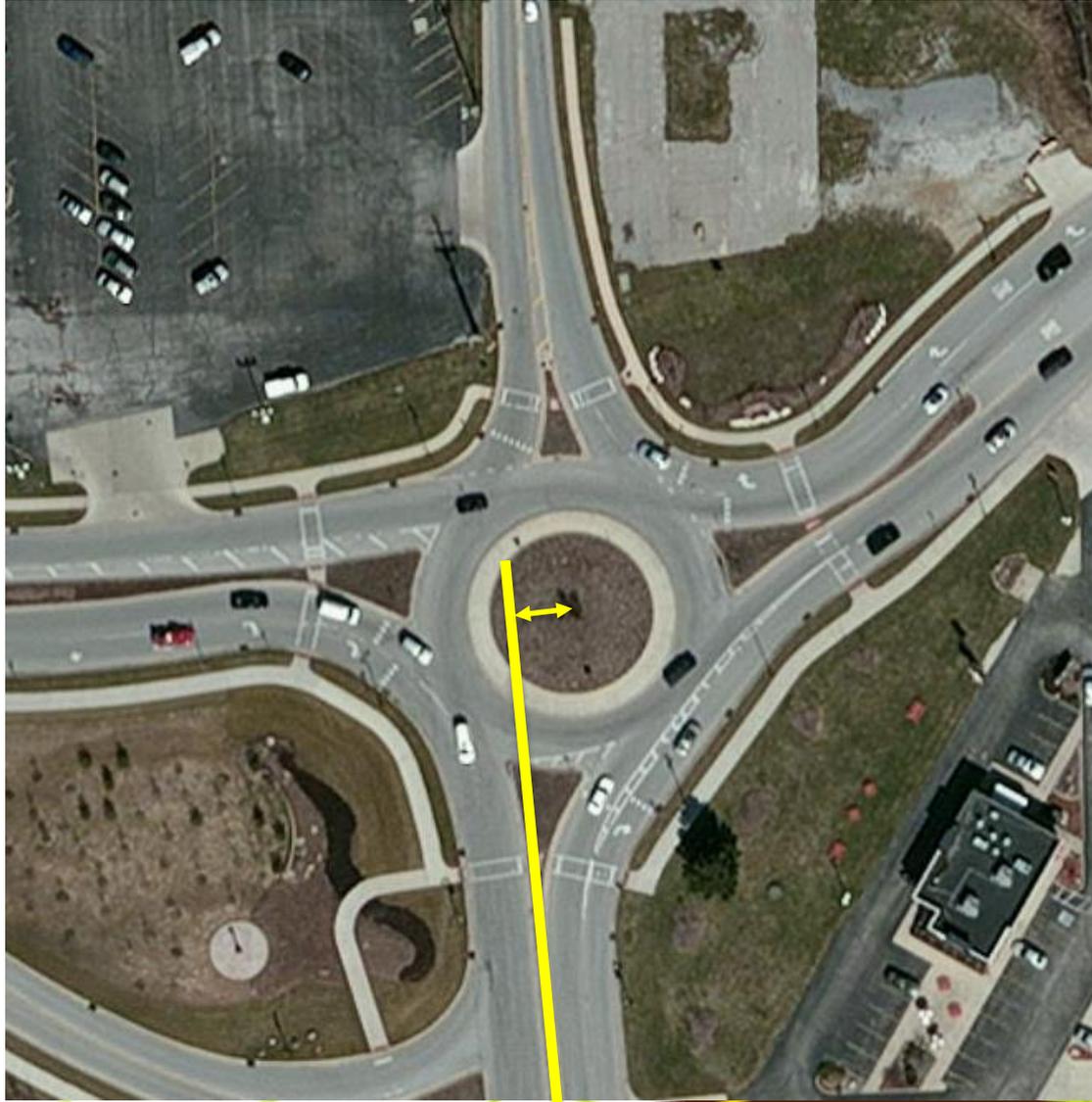
Deflection

(Source: Bing maps)



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Modern Roundabout – Key Features



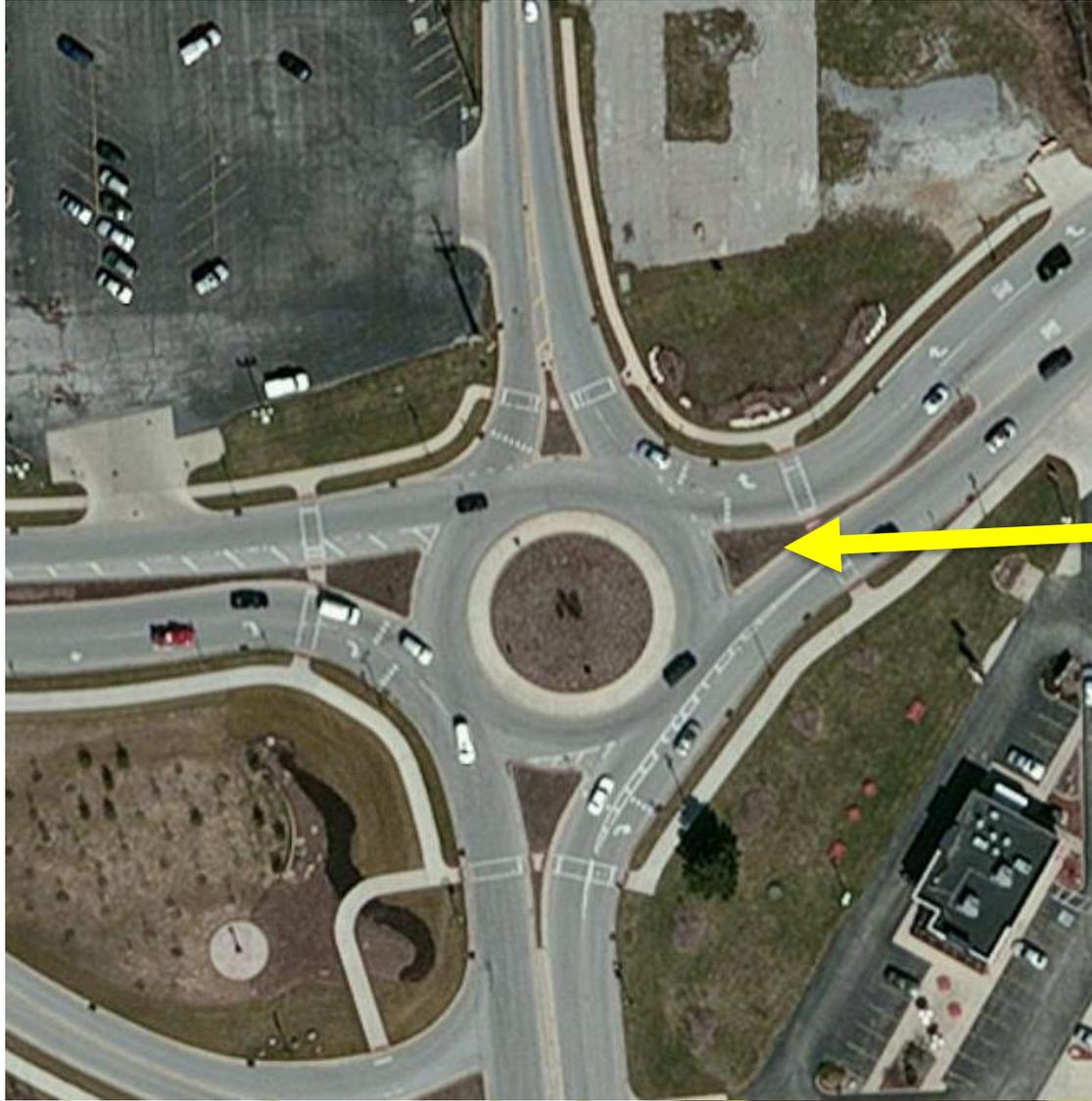
Yield control

Deflection

Offset

(Source: Bing maps)

Modern Roundabout – Key Features



Yield control

Deflection

Offset

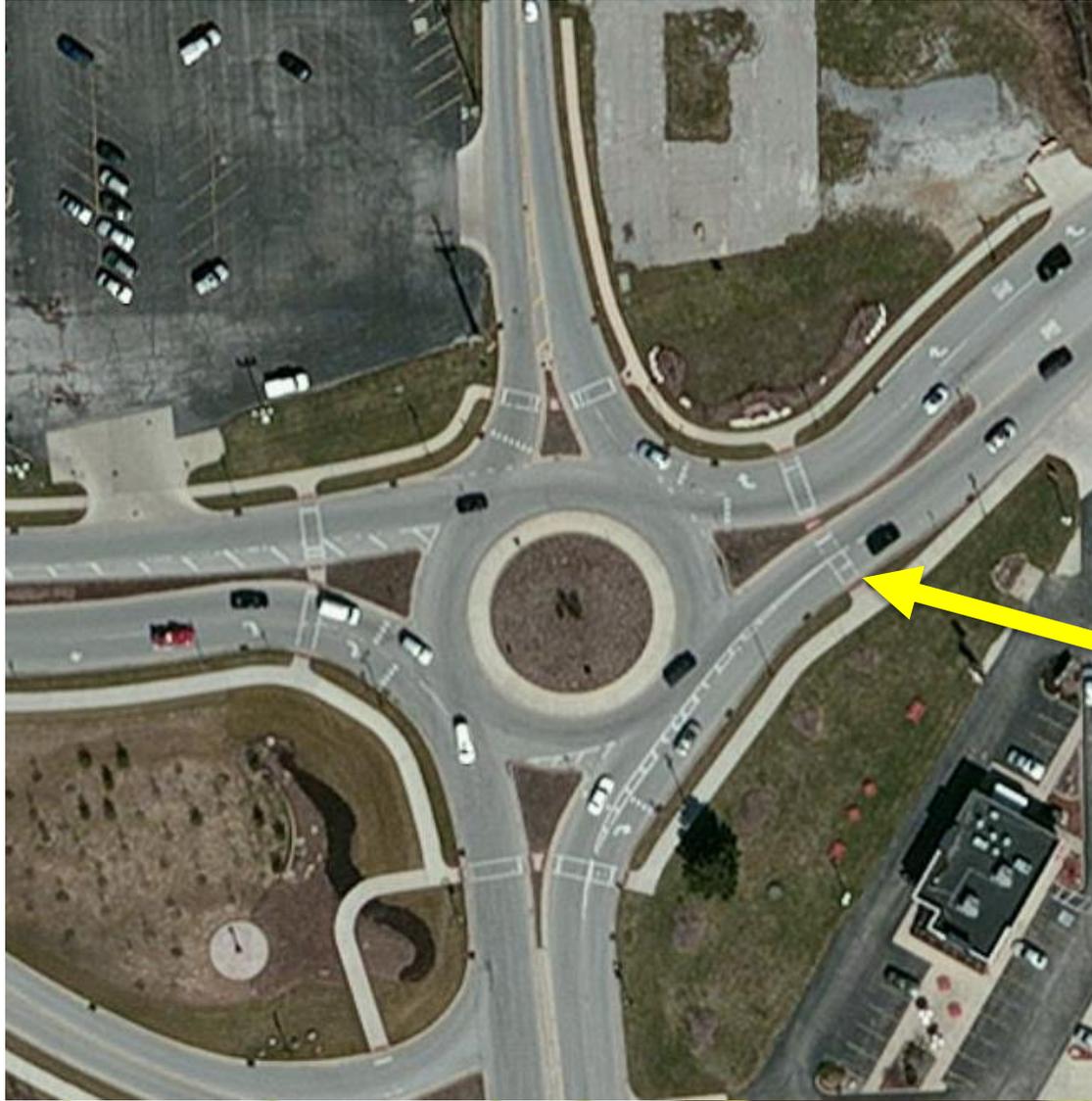
Splitter island

(Source: Bing maps)



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Modern Roundabout – Key Features



Yield control

Deflection

Offset

Splitter island

Peds crossing

(Source: Bing maps)



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Modern Roundabout – Key Features



Yield control

Deflection

Offset

Splitter island

Peds crossing

Truck apron

(Source: Bing maps)

Modern Roundabout – Key Features



Compact junction
vs.
Rotary



(Source: Bing maps)

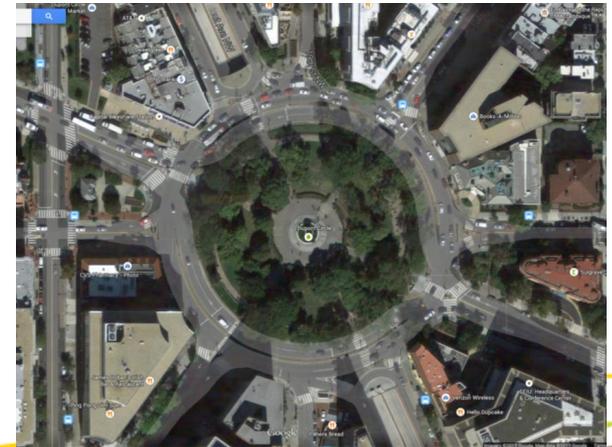
Modern Roundabout – Key Features



**No traffic control
for circulating
vehicles**

vs.

Traffic Circle

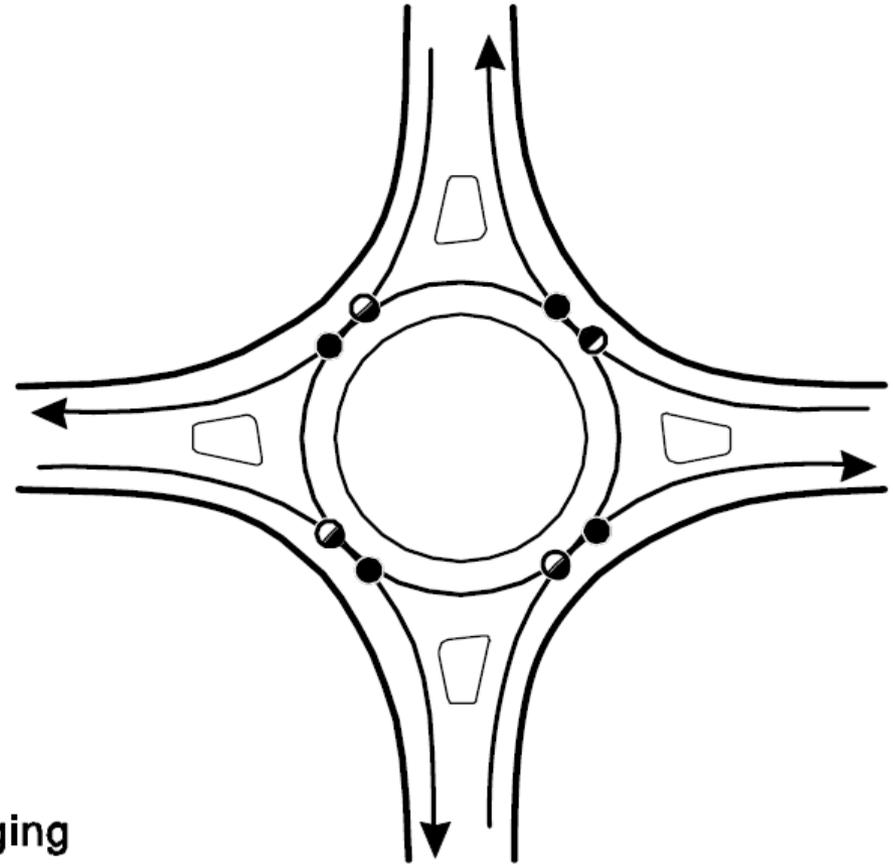
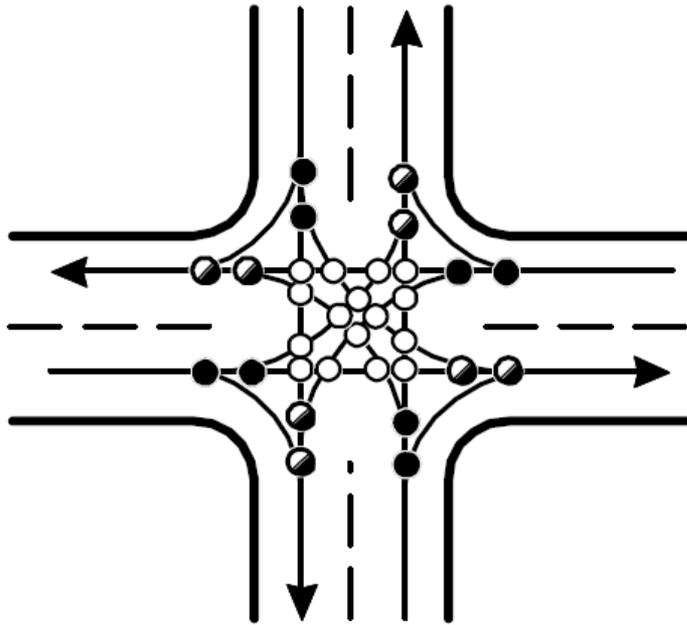


(Source: Bing maps)

Modern Roundabout

- Designed to **slow** the speed of vehicles
- Entering traffic **yields** to the circulating traffic
- Approach legs are **deflected** to reduce entry speed and channelize entry into correct lane
- **Compact** one-way circular junction
- **No traffic control** for circulating traffic

Roundabout – Safety Benefits



- Diverging
- ◐ Merging
- Crossing

(Source: NCHRP 672)



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Roundabout – Safety Benefits

- Reduced number of conflict points => lower crash frequency
- Elimination of crossing conflicts => reduced fatal/injury crashes
- Reduced speed => less severe crashes
- Reduced angle of conflict => less severe crashes
- Correct **geometric design** is key – a challenge for multilane roundabout



Signal to Roundabout Conversion



All crashes



Injury + fatal crashes



Two-way Stop to Roundabout Conversion



All crashes



Injury + fatal crashes



All-way Stop to Roundabout Conversion



All crashes



Injury + fatal crashes



Roundabout – Other Benefits

- Lower overall delay compared to signalized and all-way stop-controlled intersections
- Delay reduction most significant for off-peak periods
- Environmental benefits: reduced number/duration of stops, acceleration-deceleration cycles, idling
- Lower operating and maintenance cost
- Narrower approach roadways

Roundabout – Other Benefits

- Access management: U-turns
- Traffic calming effect: speed reduction
- Aesthetics: central island

Roundabout Trade-offs

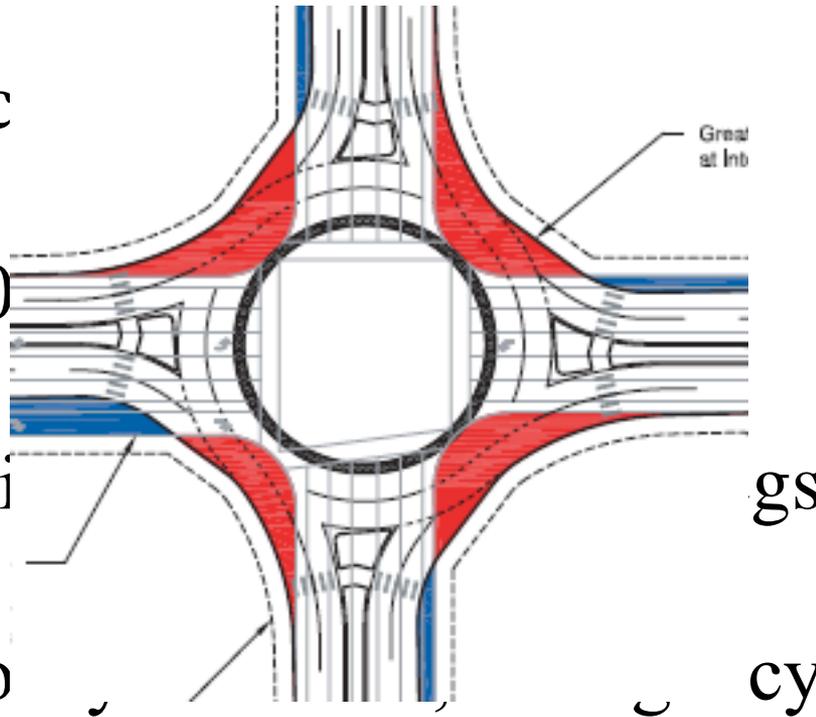
- Large footprint at the intersection

- Higher initial cost

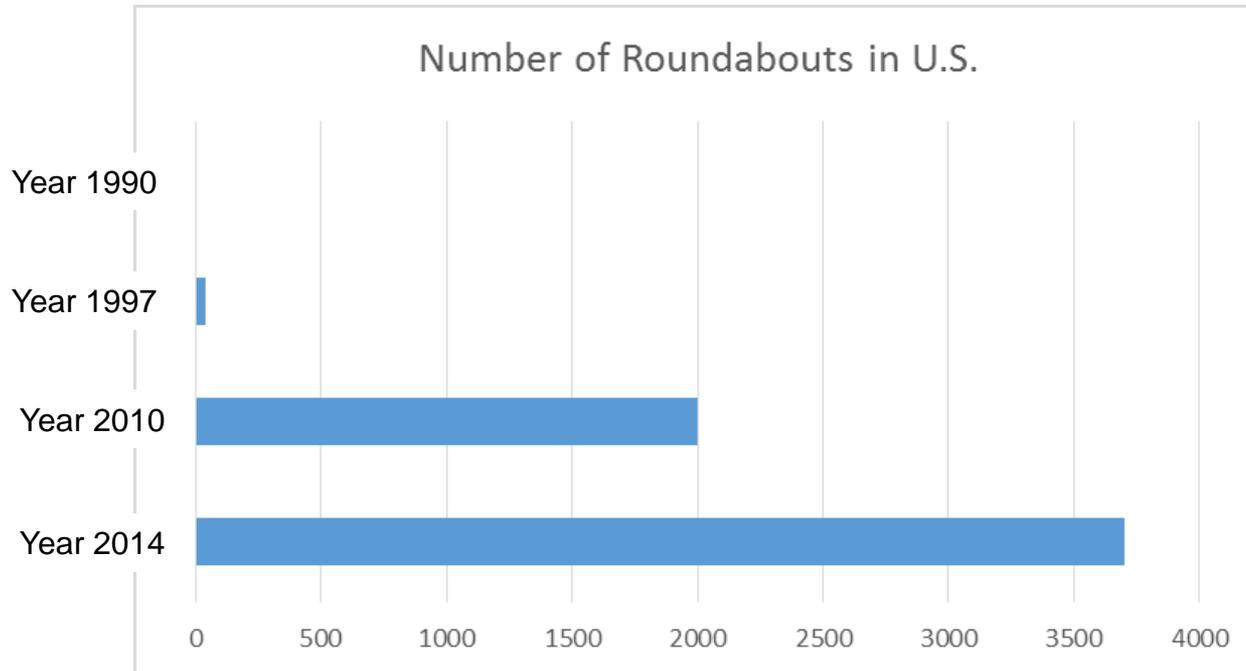
- Low-speed (20

- Gives equal priority

- Can't give priority to heavy trucks, fire trucks, etc.

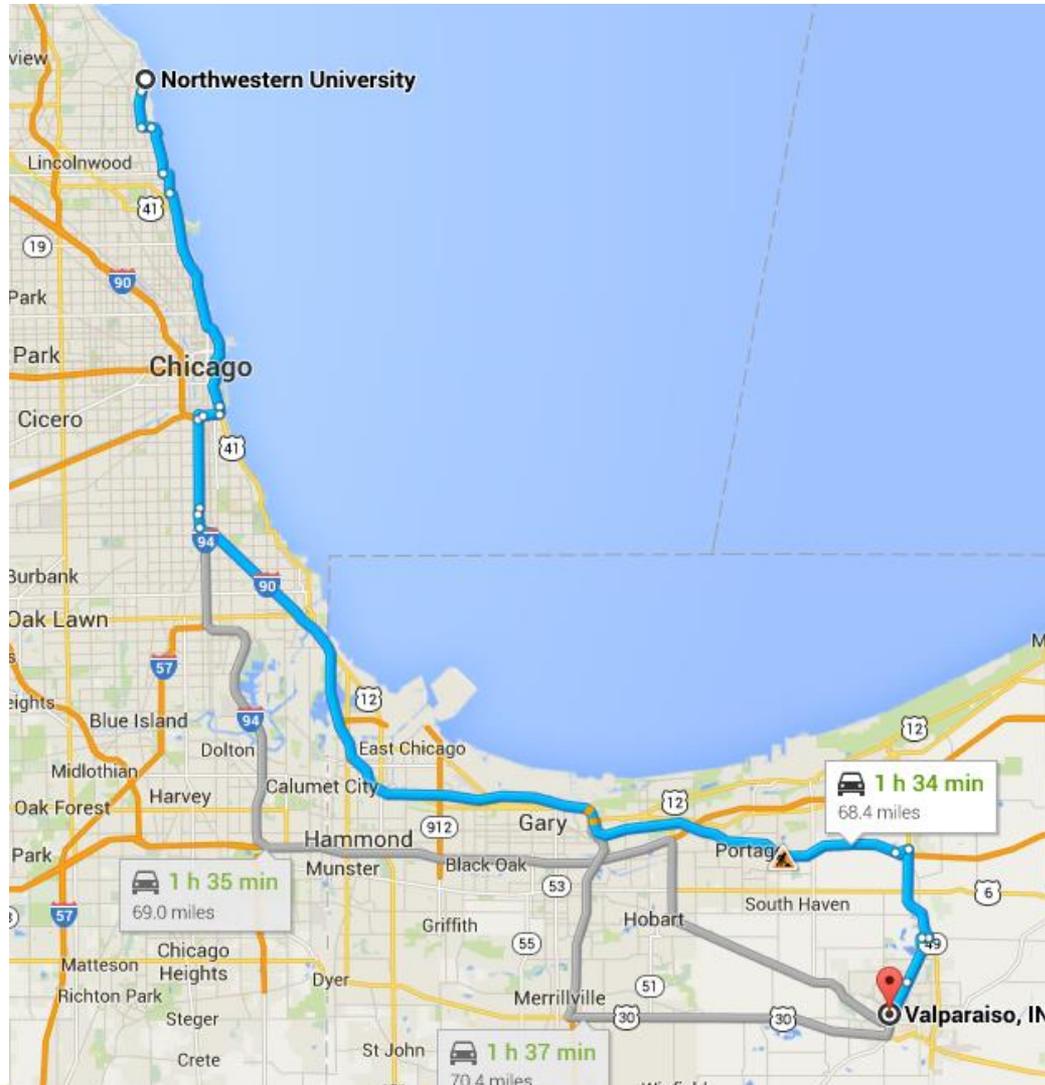


Number of Roundabouts in U.S.



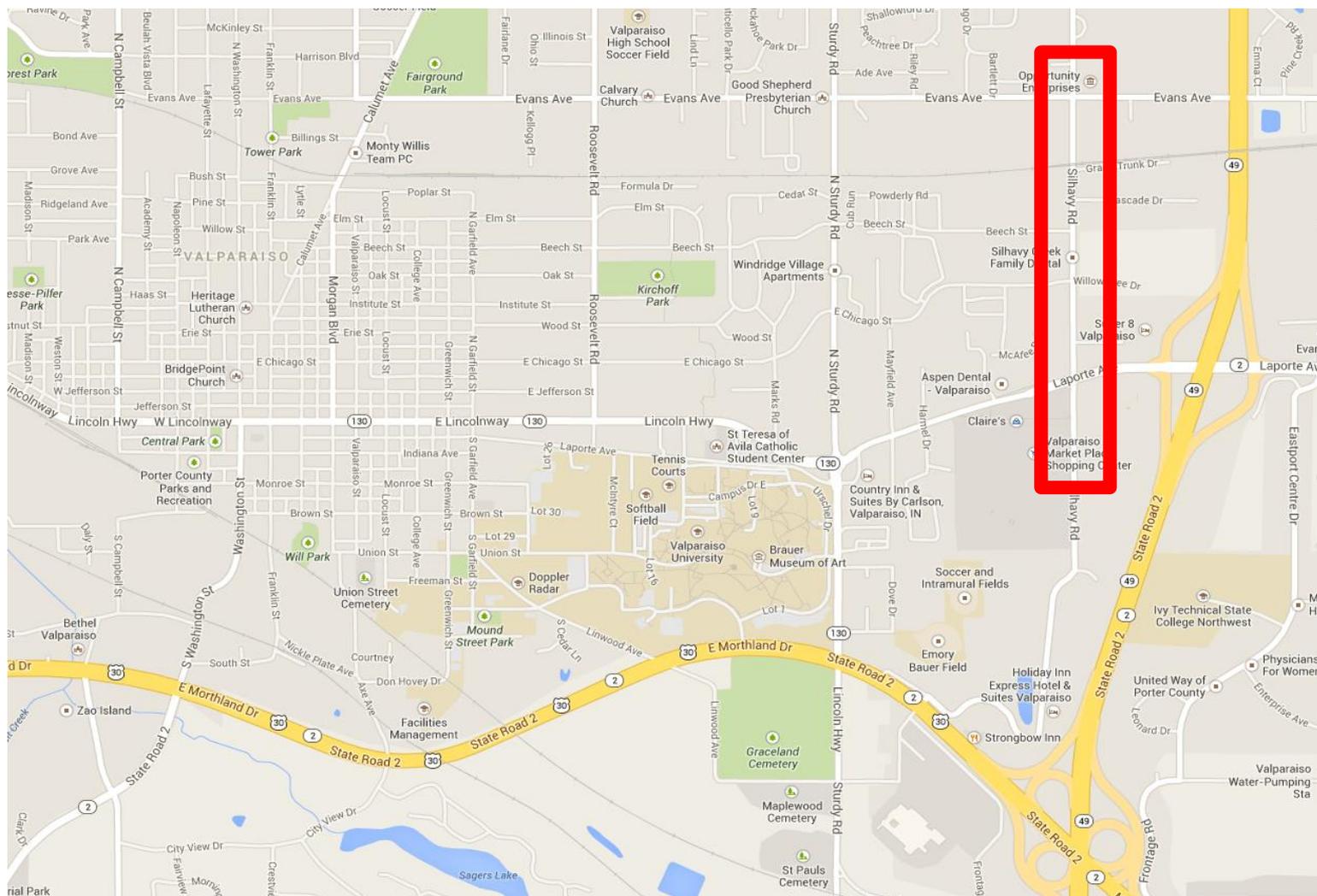
Silhavy Rd. Corridor Improvement Project in Valparaiso, IN

Valparaiso, IN



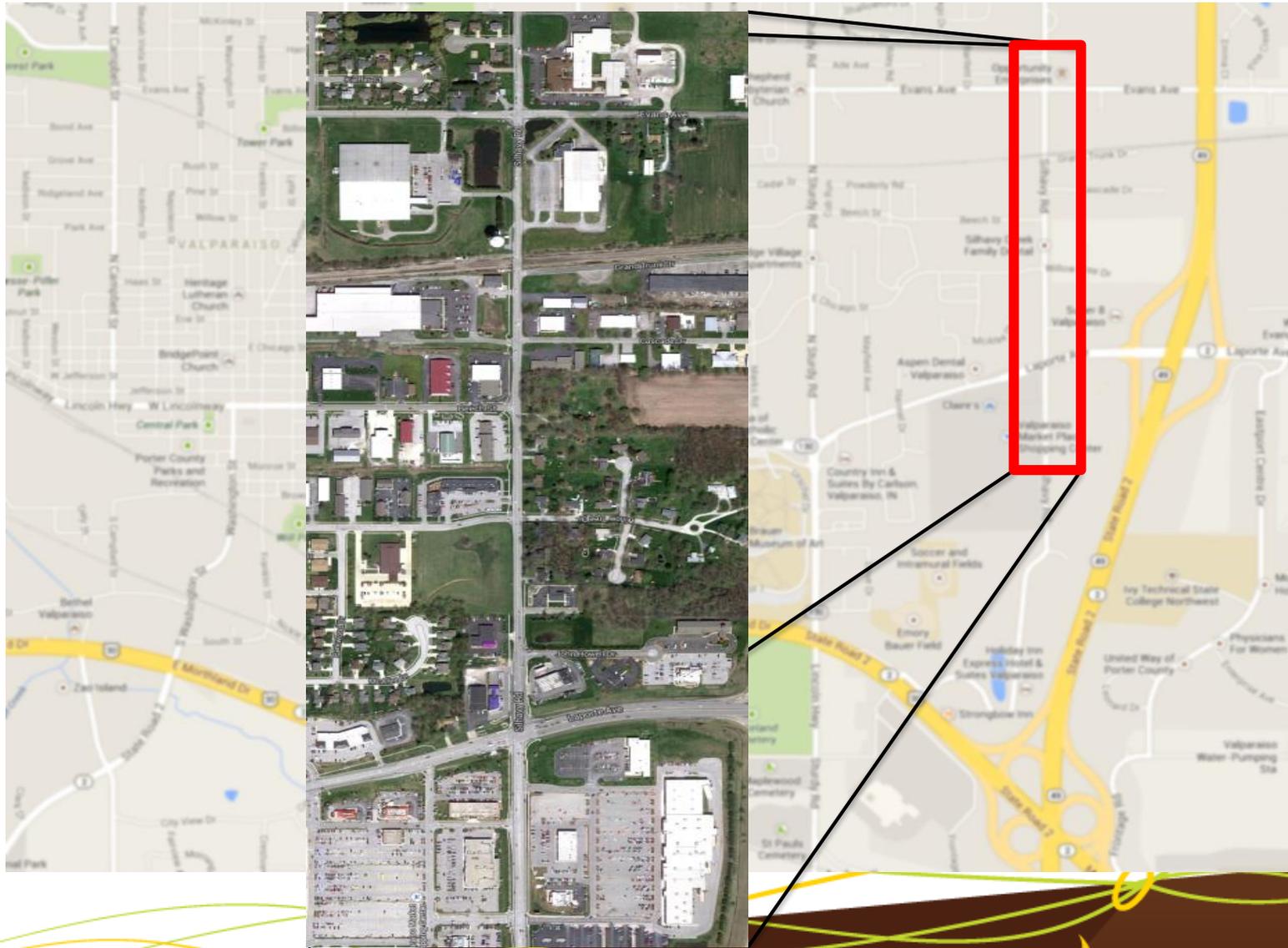
(Source: Google maps)

Silhavy Corridor Improvement Project



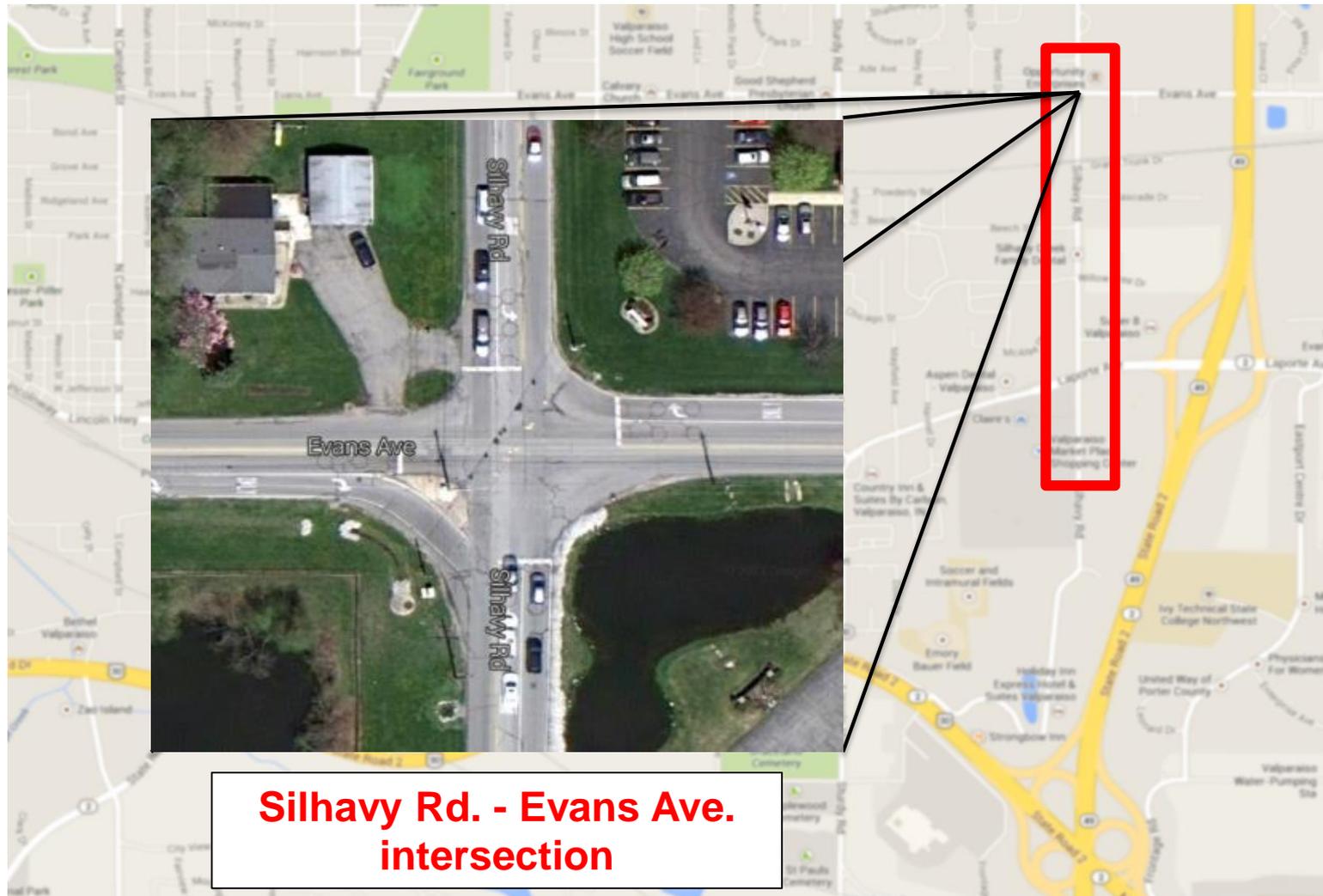
(Source: Google maps)

Silhavy Corridor Improvement Project



(Source: Google maps)

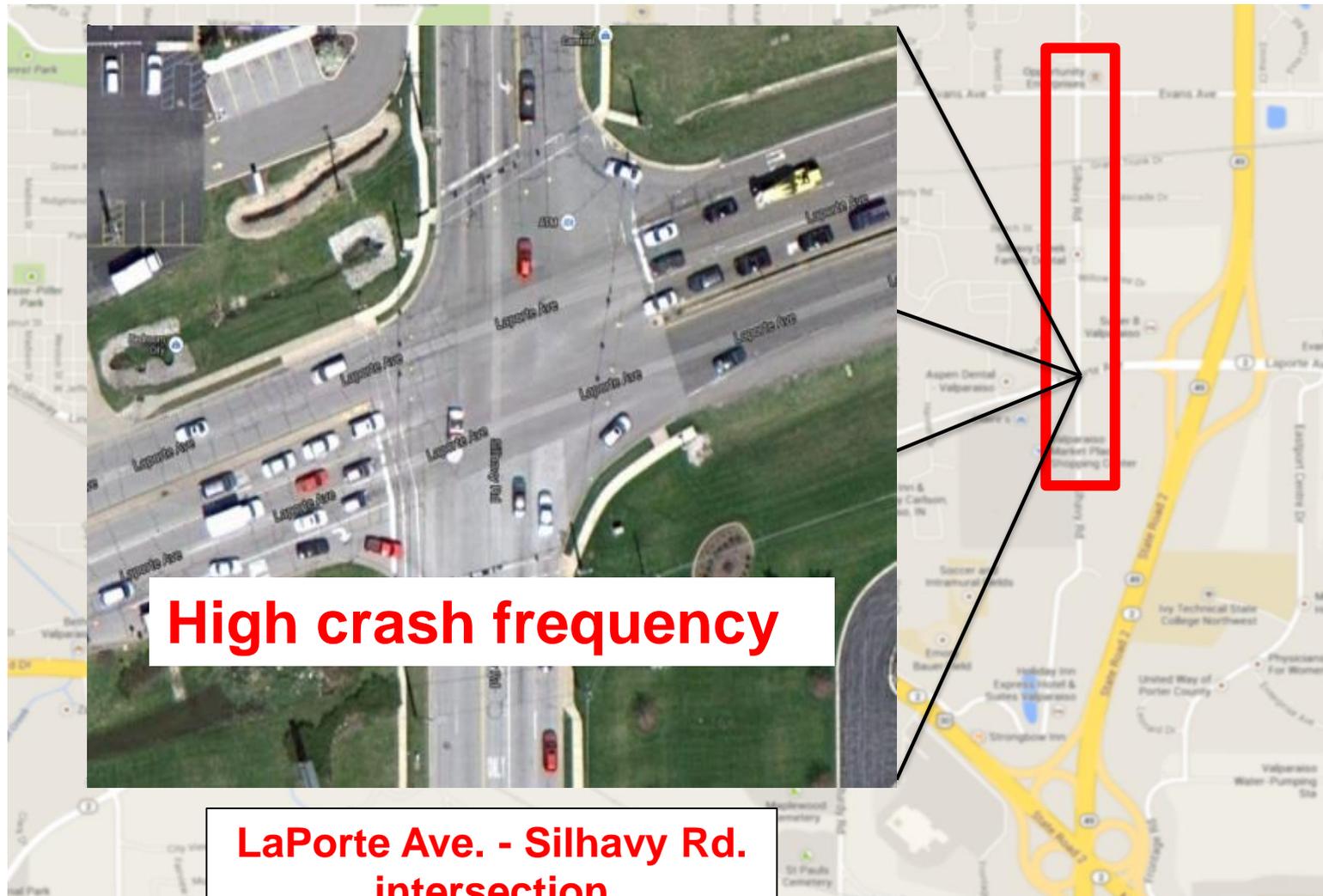
Silhavy Corridor Improvement Project



**Silhavy Rd. - Evans Ave.
intersection**

(Source: Google maps)

Silhavy Corridor Improvement Project

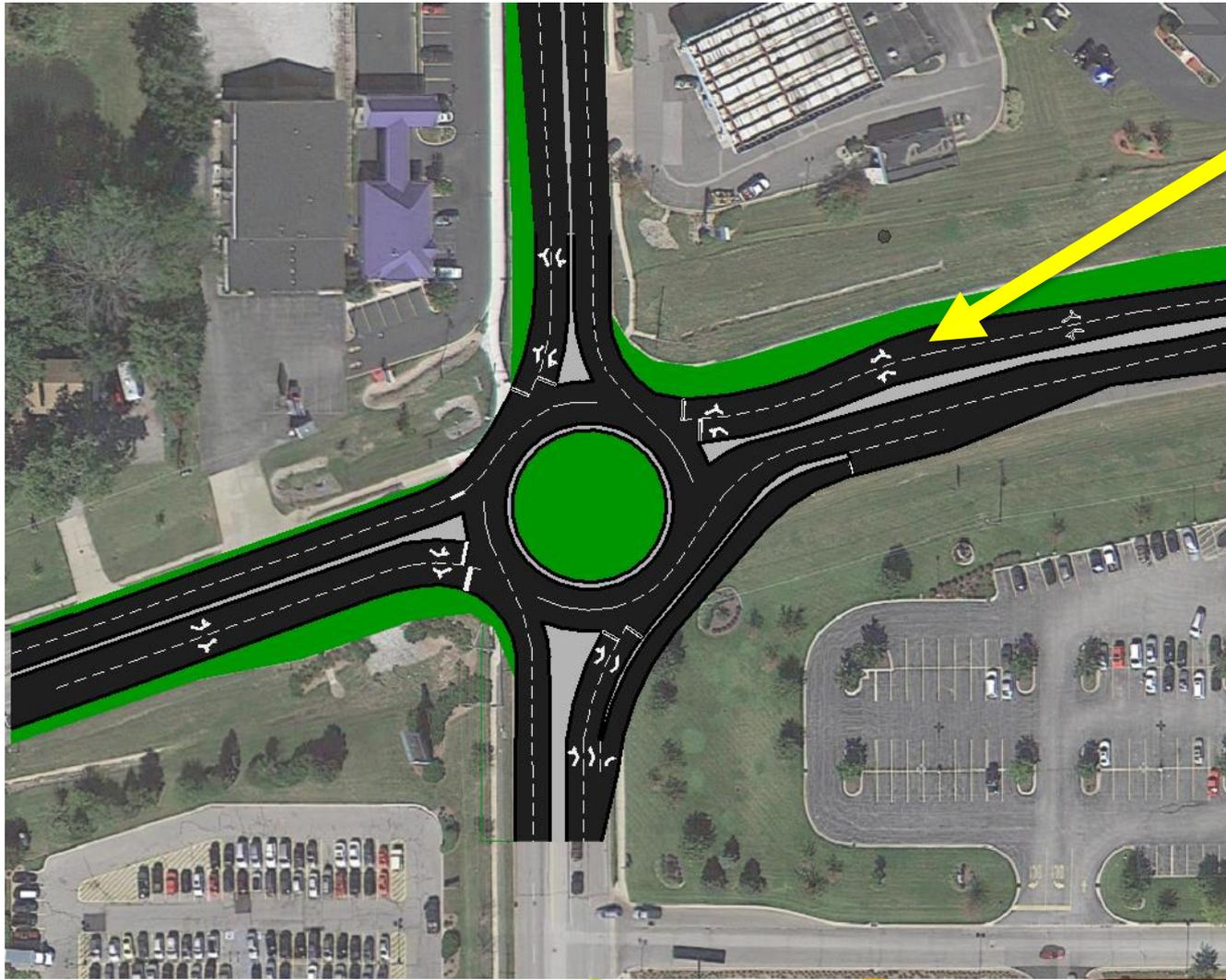


(Source: Google maps)

LaPorte - Silhavy Roundabout

- 180 ft. inscribed circle diameter (ICD)
- 35 mph design approach speed
- 25 mph travel speed in circle
- 15 foot travel lanes in circle
- Geometry determined using AASHTO Green book, FHWA guides, INDOT guides, the MUTCD

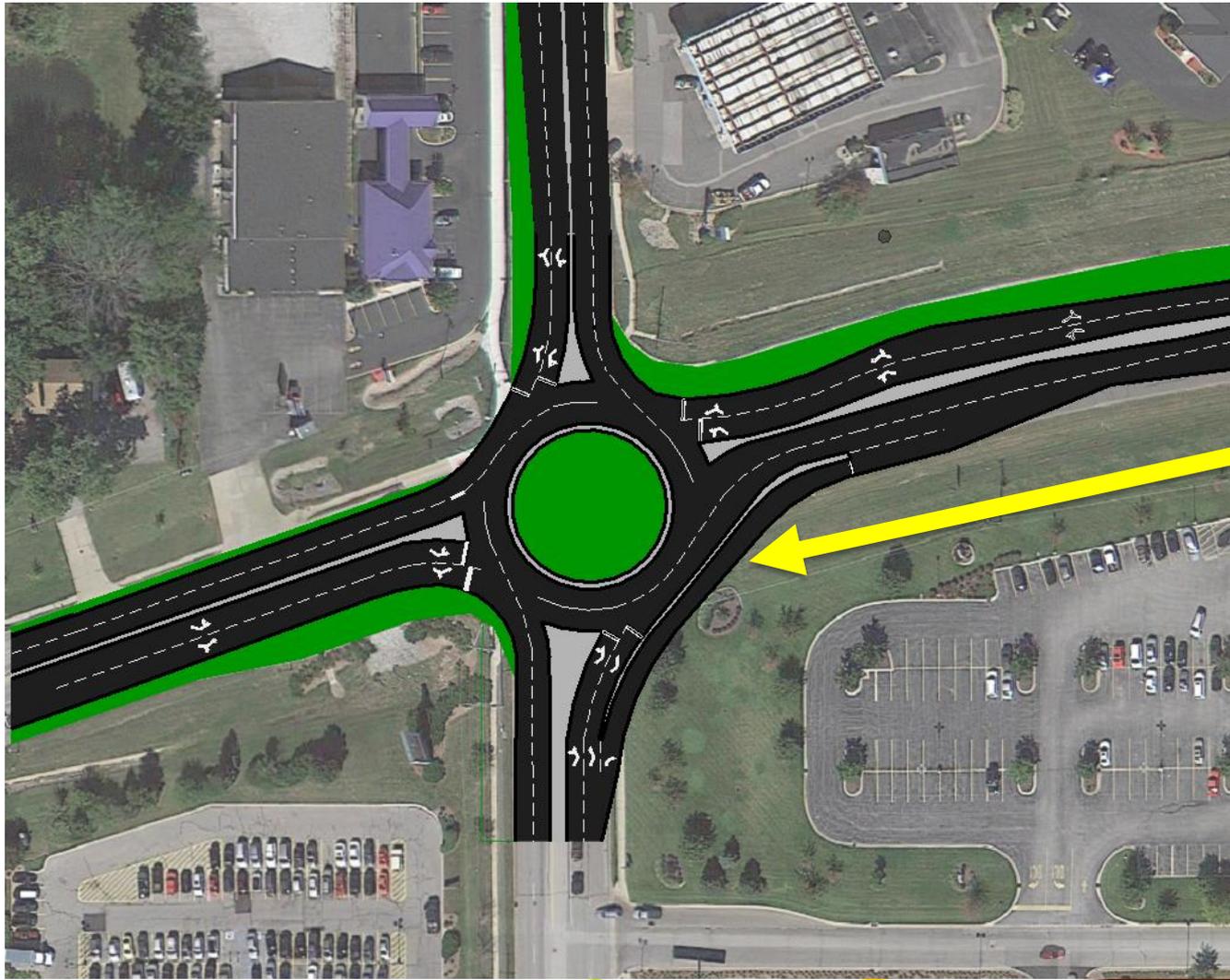
LaPorte - Silhavy Roundabout



**Speed
reduction curve**

**LaPorte Ave. - Silhavy Rd.
roundabout**

LaPorte - Silhavy Roundabout



**Right-turn
bypass lane**

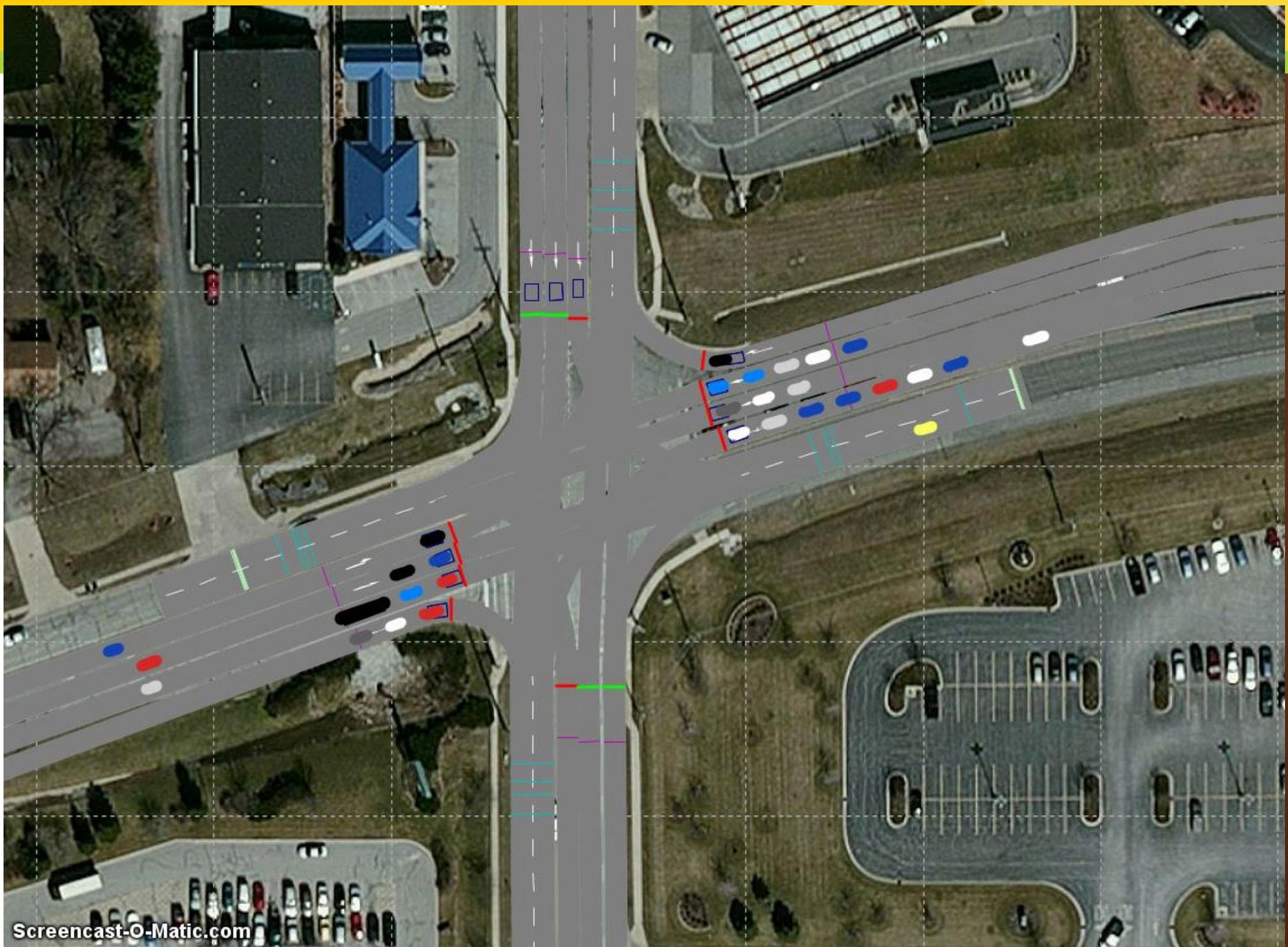
**LaPorte Ave. - Silhavy Rd.
roundabout**

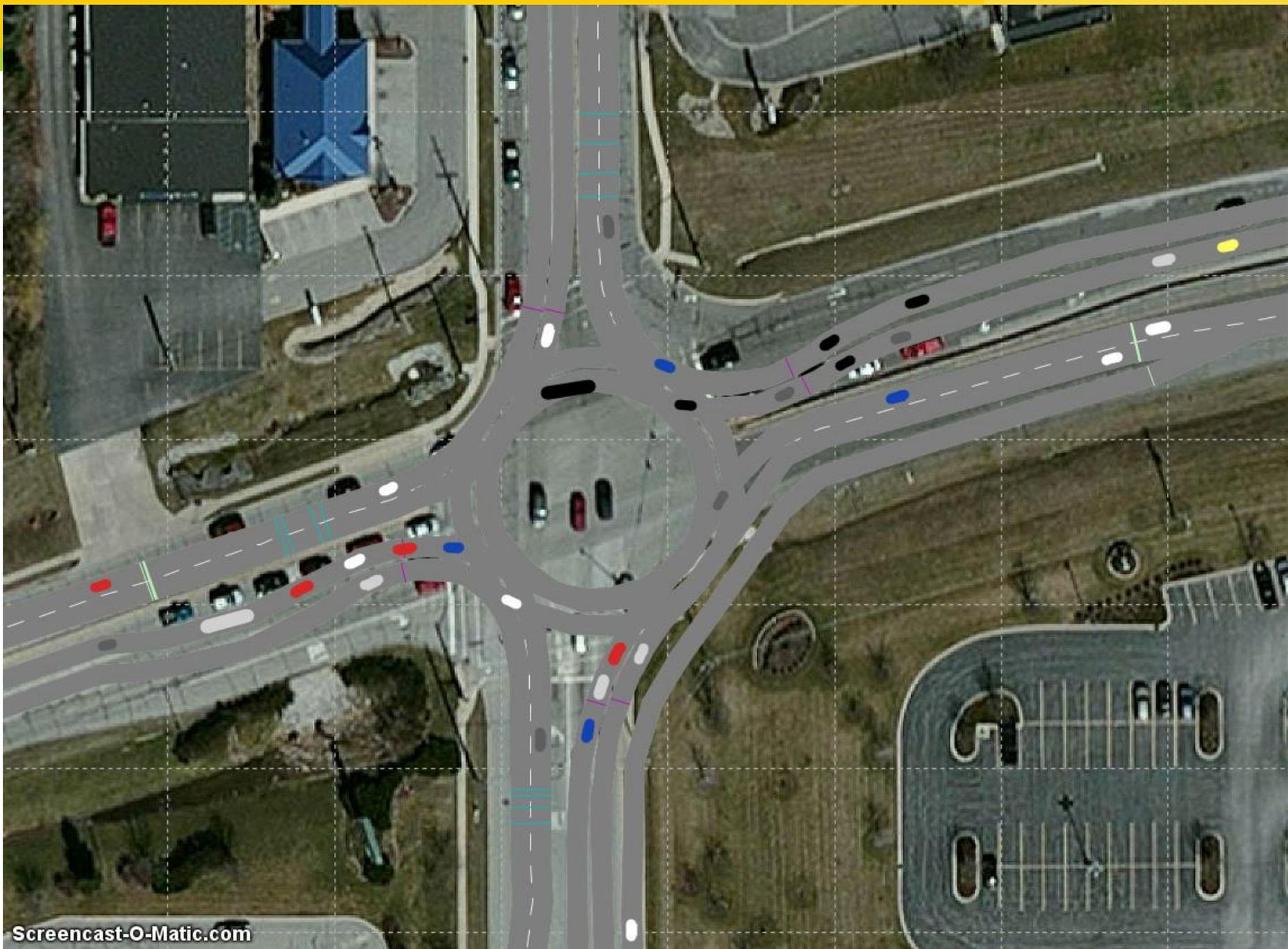


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Pedestrian Crossing Tunnels





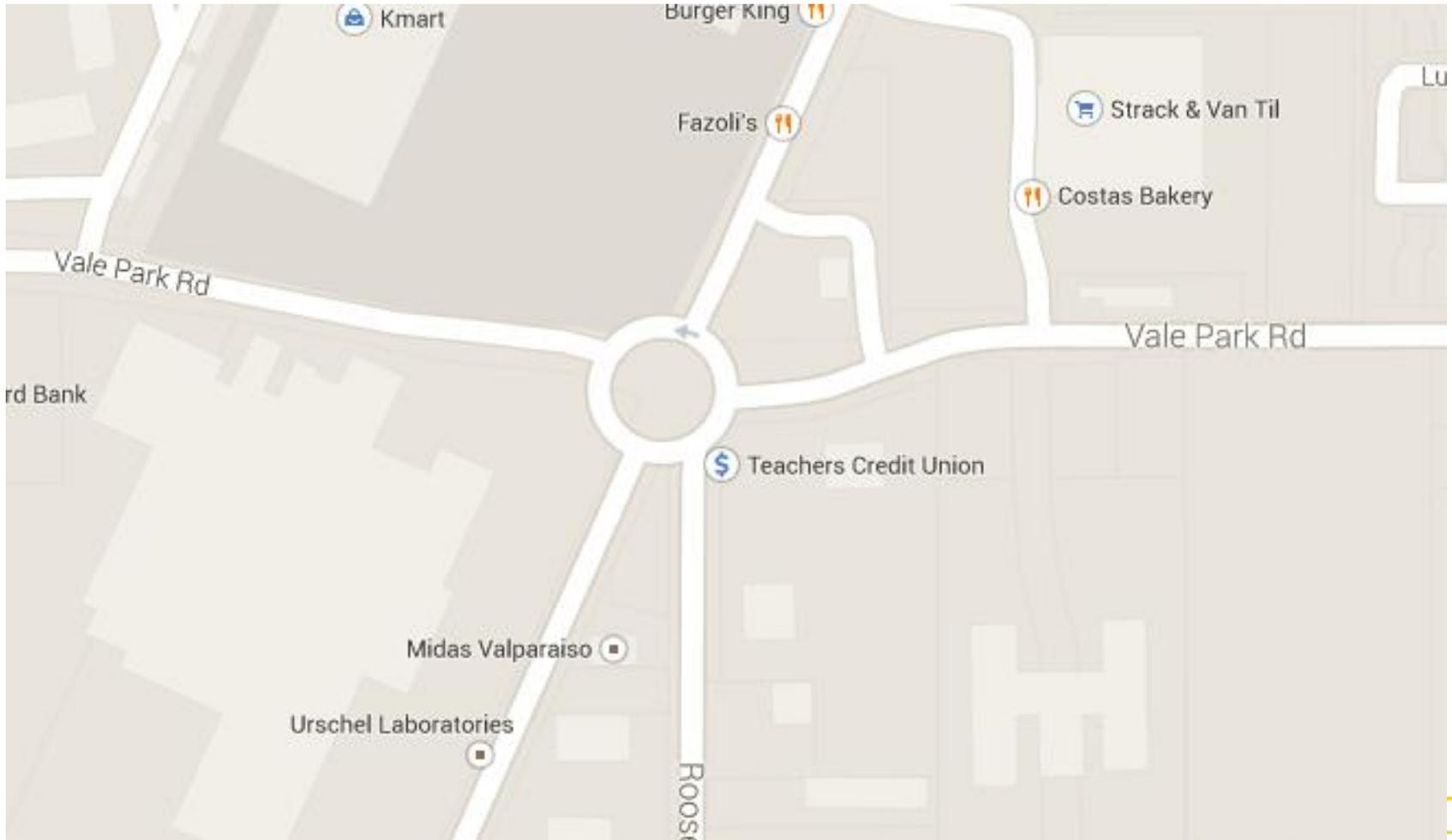


Silhavy - LaPorte Intersection

	PRESENT CONFIGURATION	DESIGNED ROUNDABOUT
Intersection Type	Signalized intersection	Two-lane Roundabout
Level of Service	LOS D	LOS B
Average Delay	40 seconds	18 seconds
Turning Vehicles	Protected left turn lanes on all approaches	Right turn bypass lane for traffic leaving shopping area toward IN49
Space / Footprint	Large intersection due to turning lanes on each approach	Design will fit over current intersection, with expansion on SE corner
Pedestrians	Pedestrian crosswalks with no islands	Design includes pedestrian tunnel, so pedestrian traffic in the roundabout is not an issue

Five-points Roundabout in Valparaiso, IN

5-points Intersection



(Source: Google maps)

5-points Intersection



(Source: Bing maps)

Past 3 years
61 crashes

11 injury crashes

Types: head on,
right angle, left
turn, signal
violations

5-points Roundabout



(Source: City of Valparaiso)

5-points Roundabout

Nearly 100 accidents at five-points roundabout in 2014

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John Luke, The Times

Motorists negotiate the roundabout at Calumet, Roosevelt and Vale Park in Valparaiso.

8 NEW CAR FRANCHISES...
just minutes from Orland Square Mall.

RIZZACARS.COM

VIEW FULL INVENTORY AT RIZZACARS.COM

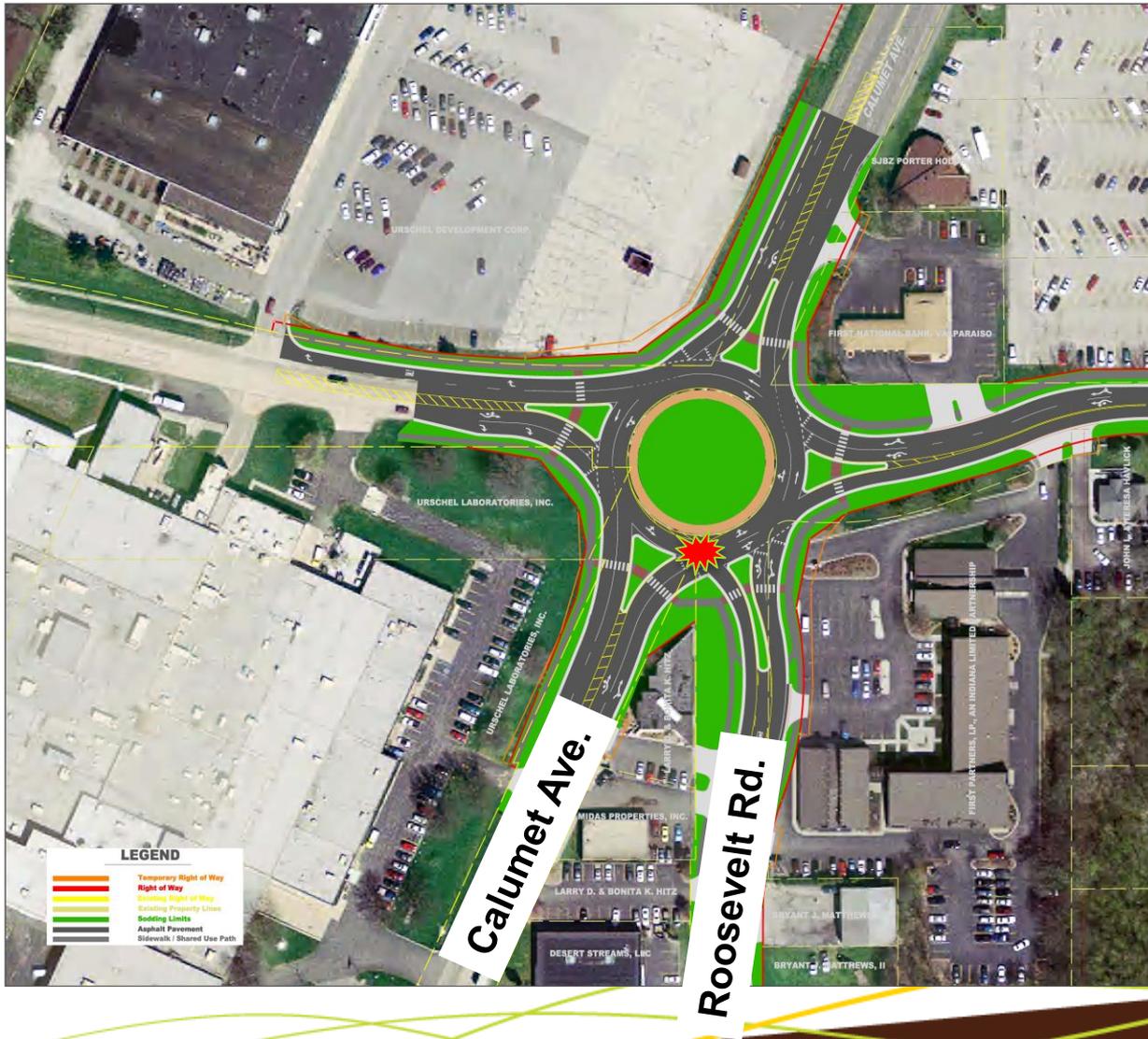
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5-points Roundabout



Year 2014

98 crashes

Majority are
minor fender
benders, side
swipes

5 injury crashes

52 crashes:
northbound
Calumet entering
too soon.

(Source: City of Valparaiso)

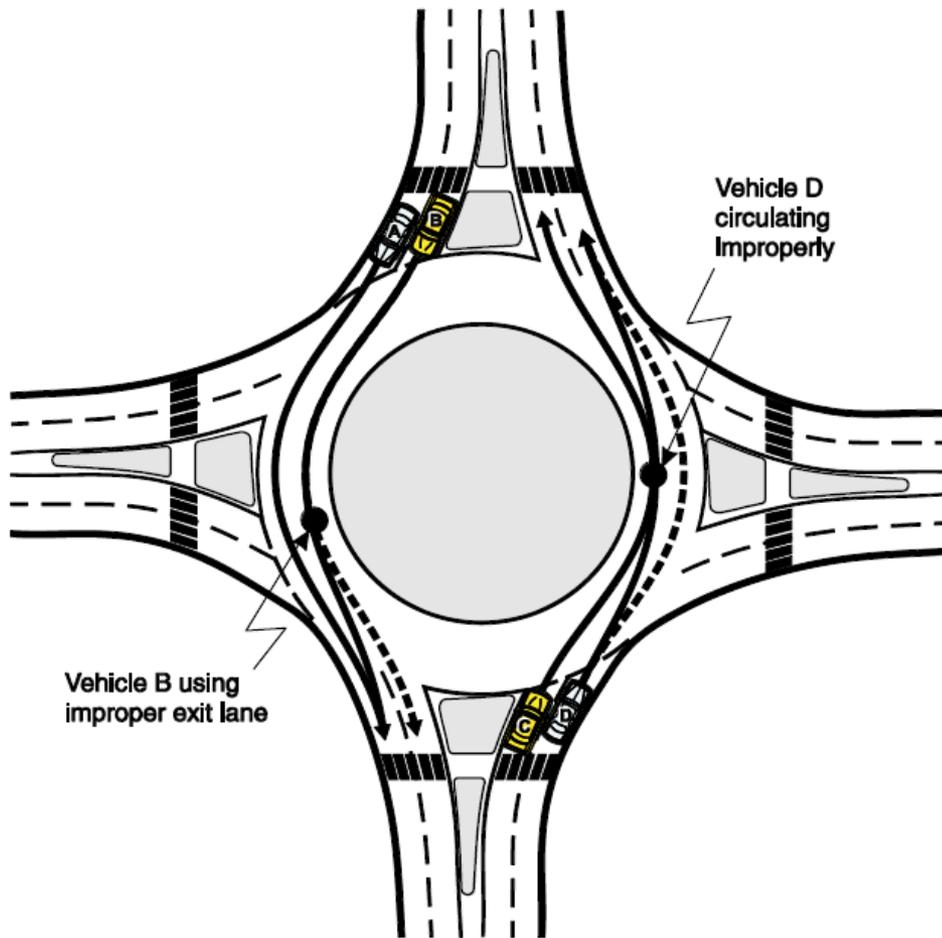
5-points Roundabout

5 injury crashes:

- Rear-end on approach legs (3 crashes)
- Northbound Calumet Ave. failed to yield (1 crash)
- Motorcycle lost traction (1 crash)

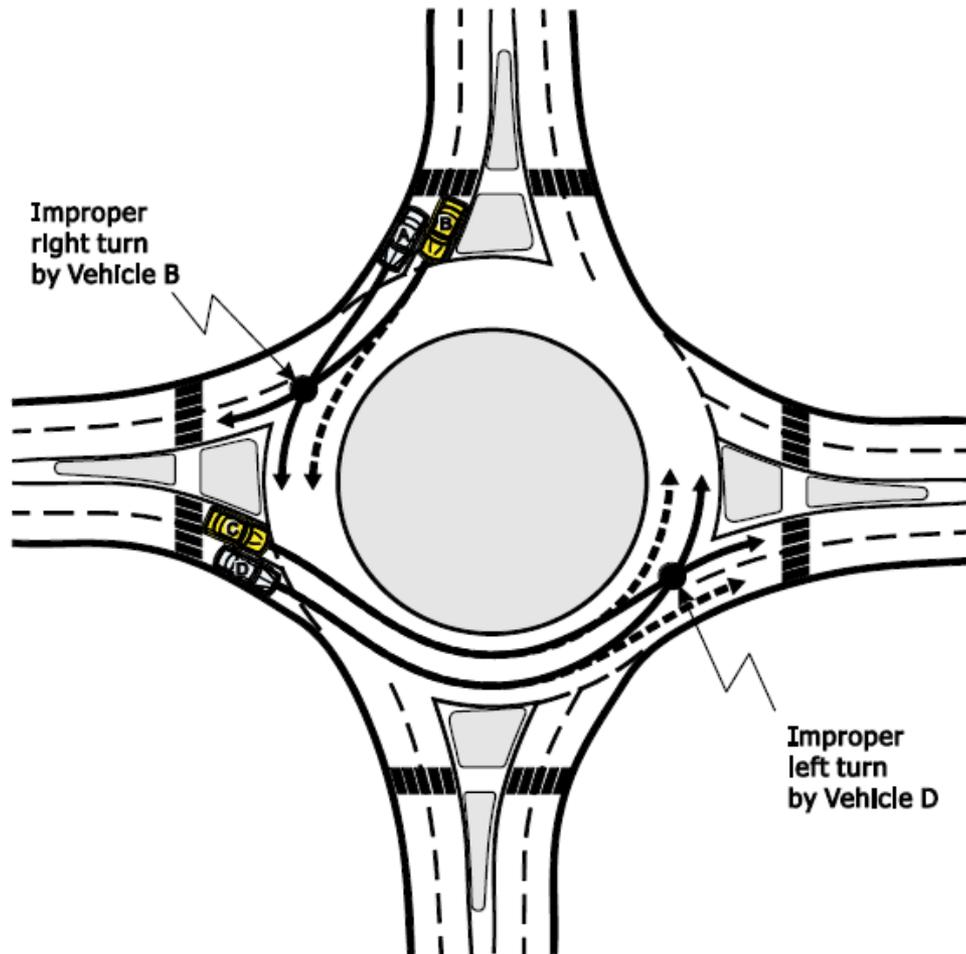
Conflicts at Multilane Roundabouts

1. Fail to maintain lane



(Source: NCHRP 672)

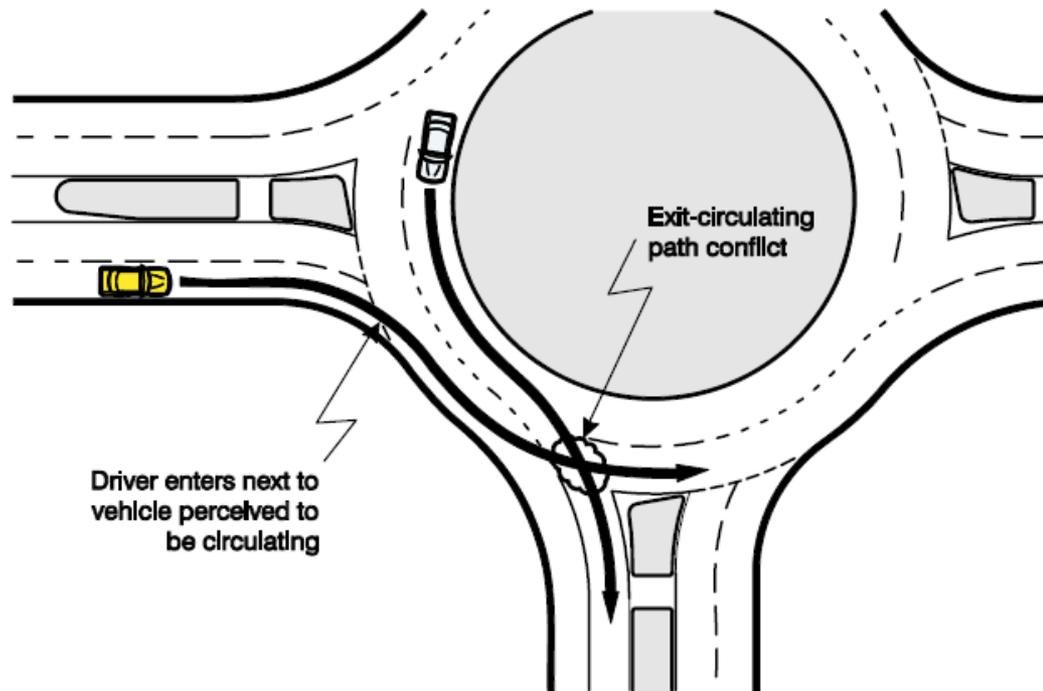
Conflicts at Multilane Roundabouts



2. Turn from wrong lane

(Source: NCHRP 672)

Conflicts at Multilane Roundabouts



3. Entering next to an exiting vehicle

(Source: NCHRP 672)

Intersection-level Safety Model

Roundabout with 5 legs & 2 circulating lanes
(AADT = 34,000 vehicles/day):

Total crash prediction = $0.0073(AADT)^{0.7490} =$
 $18.1 \text{ crashes/year}$

Injury crash prediction = $0.0029(AADT)^{0.5923} =$
 1.4 crashes/year

Bayesian revised estimates:

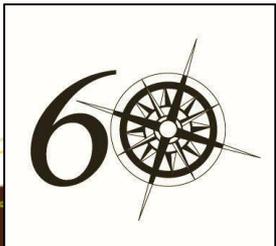
Total crash prediction = $93.4 \text{ crashes/year}$

Injury crash prediction = $3.45 \text{ crashes/year}$

Future Work

- Explore intersection-level and approach-level safety models further
- Highway Safety Manual (HSM)
- Develop a microscopic simulation model of 5-point roundabouts
- Simulation-based crash potential modeling – Surrogate Safety Assessment Model (SSAM)

Thank you!



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