

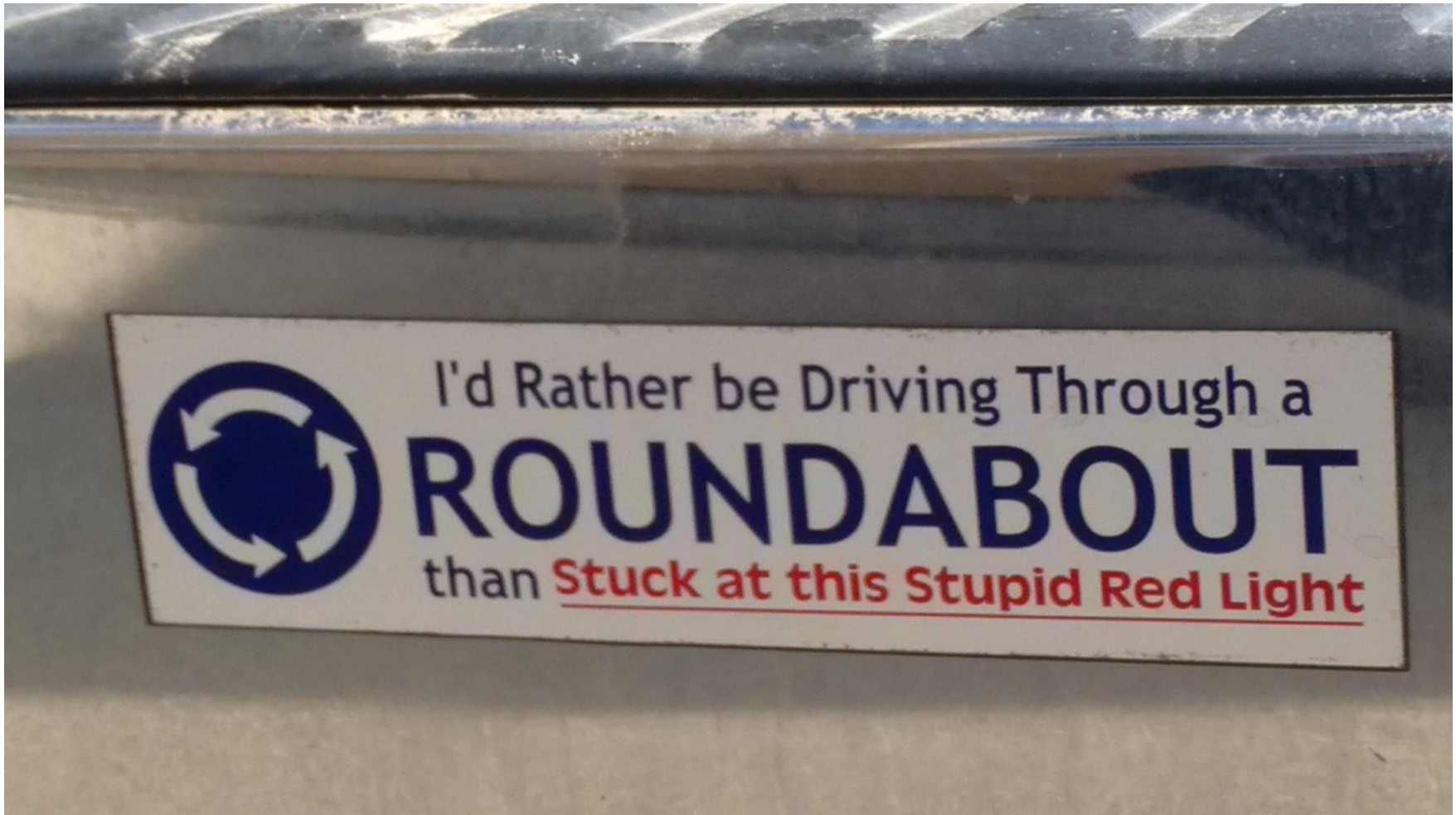
# Roundabouts



*Love 'em  
or Hate 'em?*





















HOW IT LOOKS



HOW IT FEELS



**Dont panic over  
roundabout collisions**

**How the Region  
went a roundabout  
too far**

**Education needed for roundabouts**  
tern roundabouts are relatively new in Ontario and are growing

**Roundabout dance continues**  
Research shows that collisions at traffic signals experience more deaths compared to roundabouts. Of the 50+ roundabouts in Waterloo Region, none have experienced a fatality since their installation. While roundabouts lead to higher accident rates, they are usually minor with little damage and fewer injuries. Traffic in roundabouts is moving slowly in a clockwise direction and at frequent intervals to their right. Modern roundabouts have a potential for

**Love 'em or hate 'em,  
roundabouts are here to stay**

**Is this the fender bender ender?**  
Maintaining traffic during construction of a roundabout is important as the travelling public can be educated on roundabout operation during construction. Based on our experience we do not believe that drivers should be directed to drive on the wrong side of the road during construction. We believe that

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## Roundabouts tricky in a car centred culture

## Politicians weigh in on roundabout safety

## Roundabouts and schools dont mix

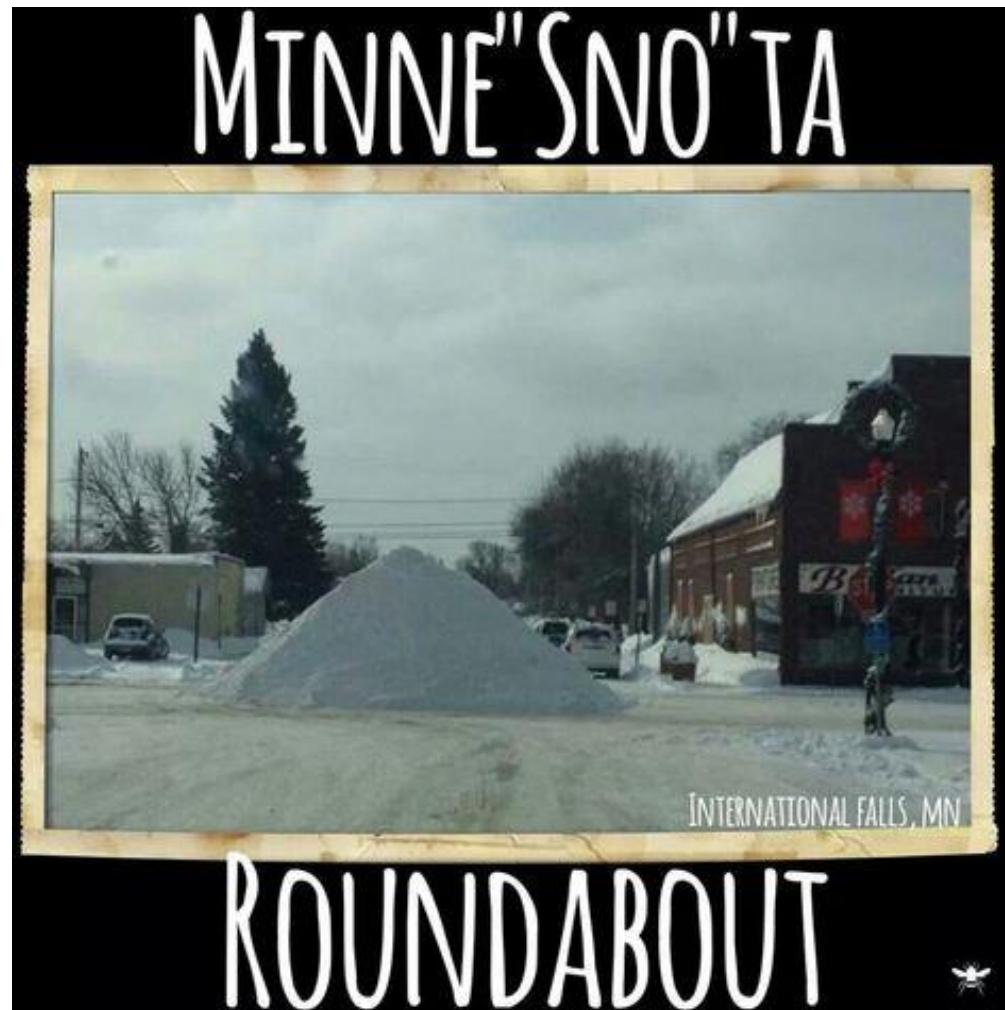
Since the installation of roundabouts in the region, snow removal  
operators had provided the Region with their concerns which resulted

## Police Chief defends roundabouts

## High school kids see jobs of the future in bridges and roundabouts

## Roundabout victim intends to sue, lawyer says





# Americans when they approach a roundabout



People these days

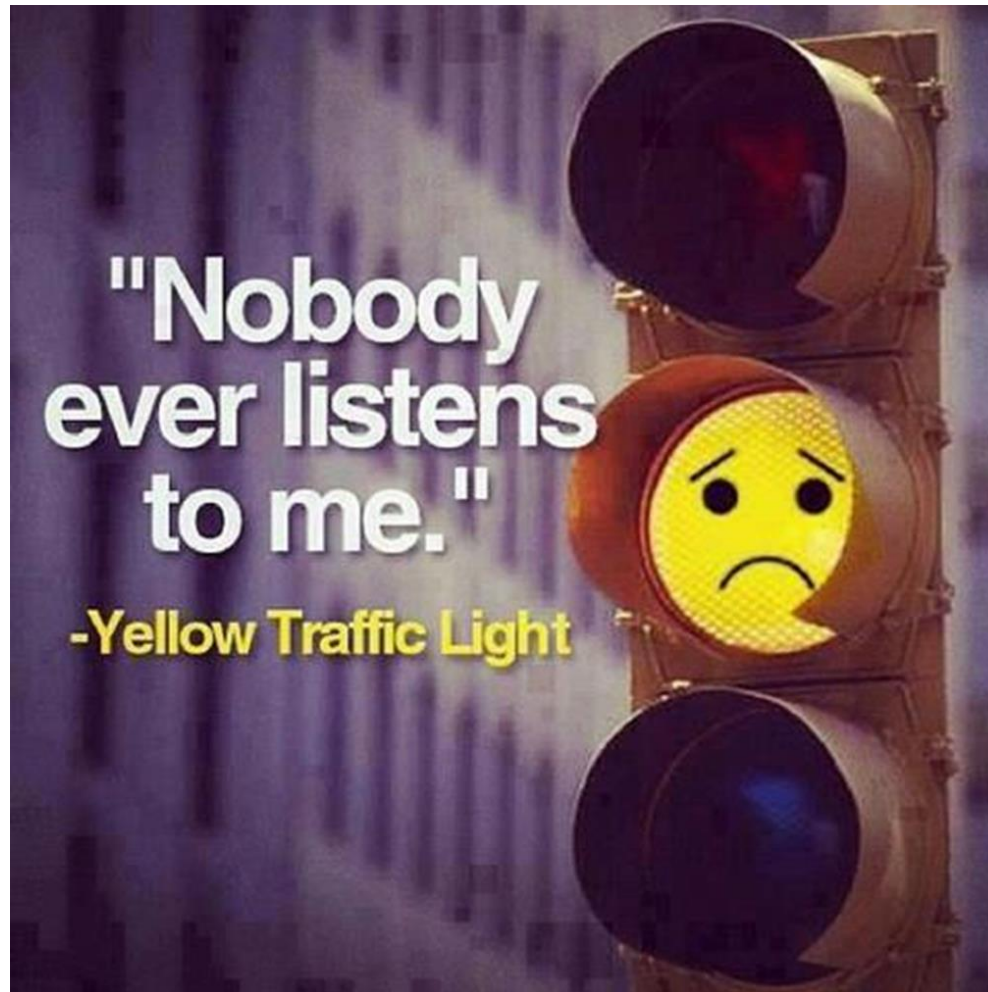
# Why is it so Difficult to Drive a Roundabout?

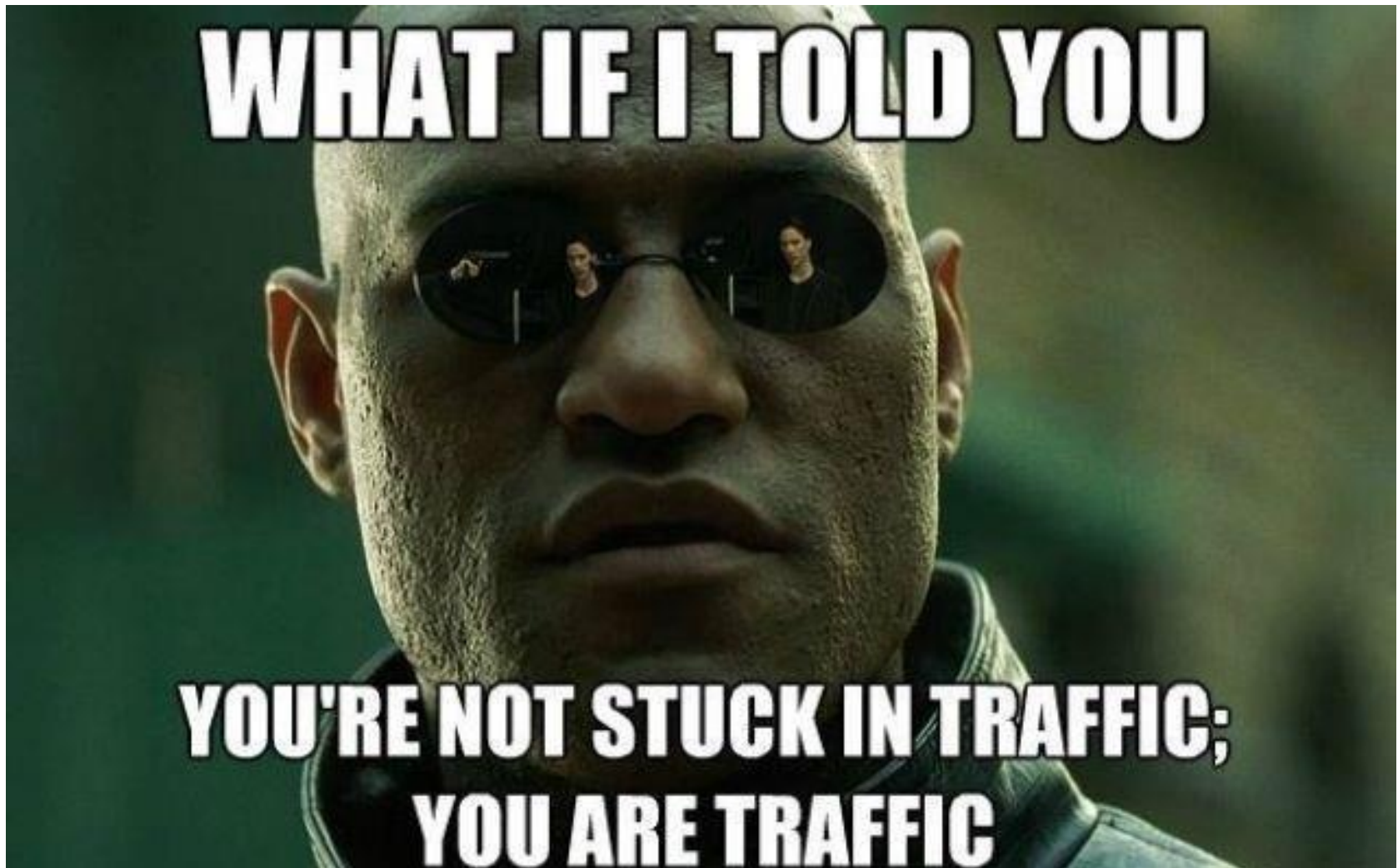
<u>ROUNDAABOUT RULES</u>	<u>SIGNALIZED INTERSECTION</u>
<b>1. Slow Down</b>	Should slow down when approaching a signalized intersection
<b>2. Look and Plan Ahead</b>	Good idea to look and plan ahead – drivers often plan ahead by scanning the side streets and watching pedestrian signal
<b>3. Yield to Pedestrians</b>	Should yield to any pedestrian
<b>4. Yield to All Traffic in Roundabout (only need to look to left)</b>	Should yield to any traffic from any direction in an intersection
<b>5. Don't pass vehicles in a Roundabout</b>	If you pass a vehicle in an intersection, you are likely going too fast!
<b>6. Signal</b>	Must signal turn
<b>7* Left lane - turn left, right lane - turn right</b>	Turn left - left lane, Turn right - right lane



# It's a North American Culture Thing

	Five Reasons why (North) Americans will Never Love Roundabouts (Wes Siler)
1. Safety	<p>Green Light → <b>GO</b>  Red Light → <b>STOP</b></p> <p>Drivers can focus on what is really important – iPhones, Big Macs &amp; Coffees</p>
2. Divine Right	.....to cut people off! (My time is more important than yours)
3. Culture	N.A. Cultural contribution makes up for wasting natural resources – American Graffiti...racing between stop lights
4. Other People	We don't like other people – Car is a sanctuary - Drive Thru's, iTunes, Podcasts, Radio Shock Jocks
5. Bad Drivers	Country built on "All people created equal" – even those that can't drive.







# Roundabouts 101

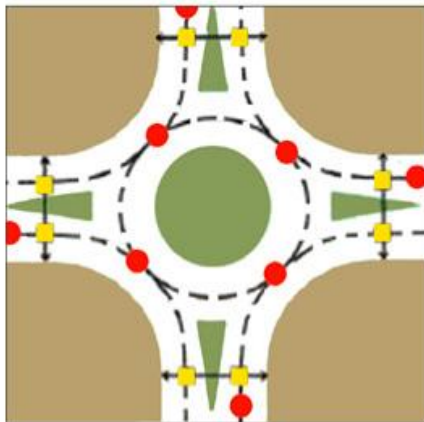
# Roundabout Advantages

- ✓ Safest type of at-grade intersection for motorists
- ✓ Better safety for pedestrians
- ✓ Higher capacities / shorter delays
- ✓ Safe mid block left turns
- ✓ Can enhance community
- ✓ Lower vehicle noise, fuel consumption and emissions through fewer starts/stops and delays.
- ✓ Can have Traffic Calming Effects
- ✓ Can maintain traffic during construction

# Why Roundabouts are Safer – Conflict Points

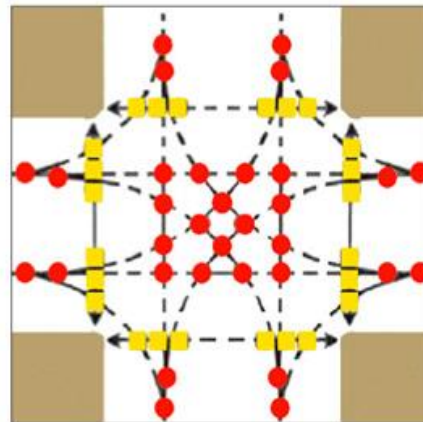
- Much fewer conflicts points, 8 vs 32
- Eliminate turning conflicts for pedestrians
- Vehicle speed lower – side swipe or bumper crashes.

## Roundabout



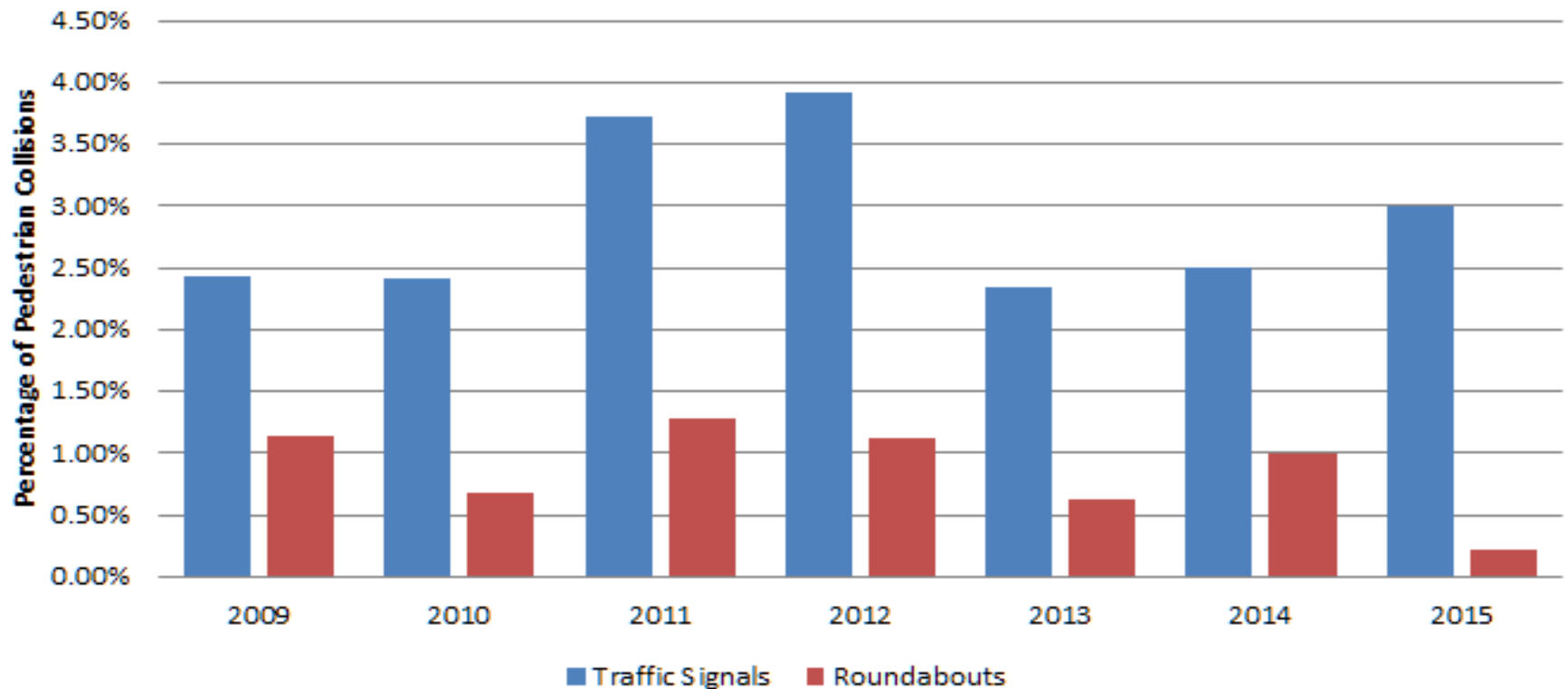
● 8 Vehicle conflicts  
■ 8 Pedestrian conflicts

## Intersection



● 32 Vehicle conflicts  
■ 24 Pedestrian conflicts

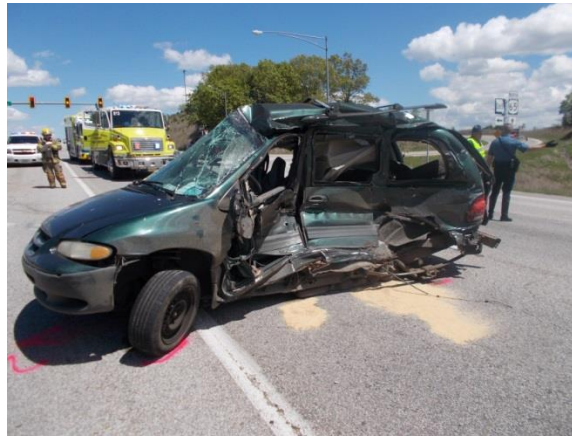
## Percentage of Pedestrian Collisions by Traffic Control





# Why Roundabouts are Safer

- Lower Accident Severity



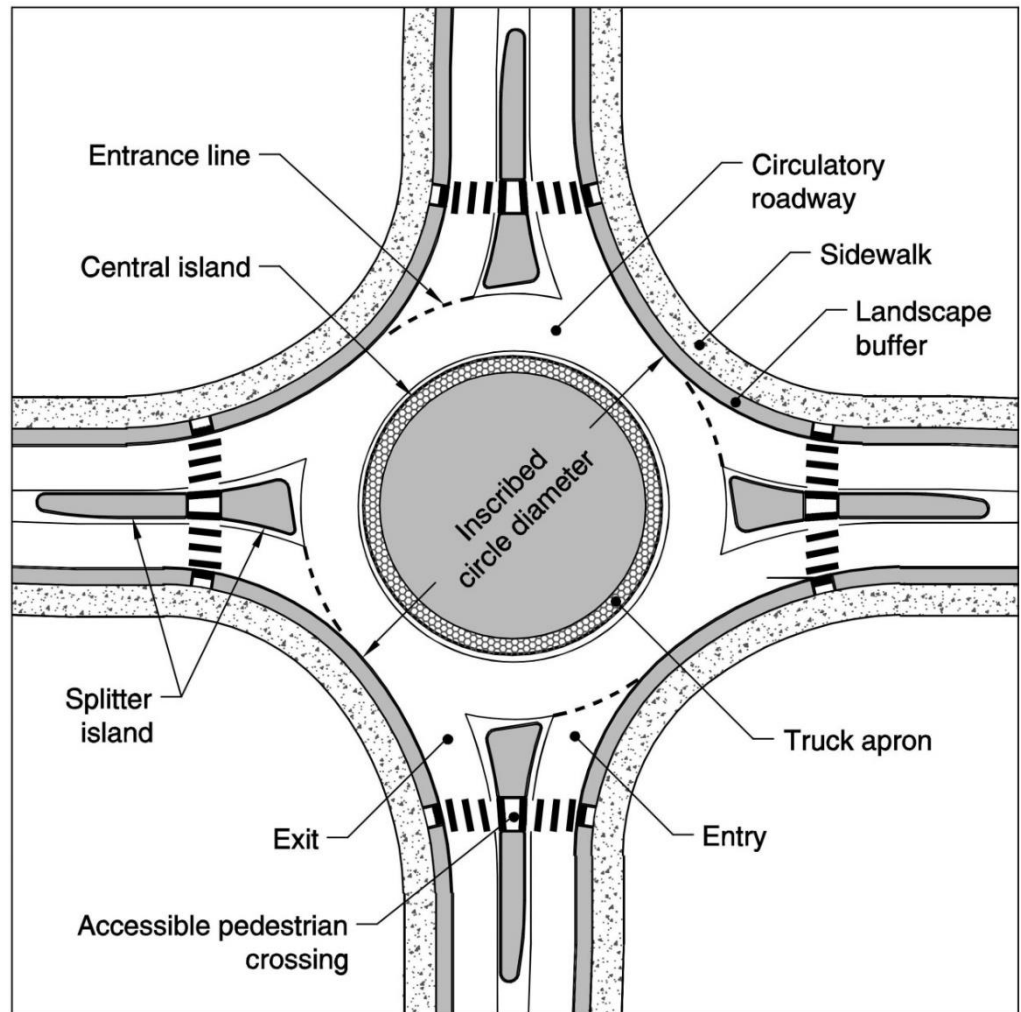
# Disadvantages

- ✓ Can cost more to construct
- ✓ Property requirements
- ✓ Construction staging can be complicated
- ✓ First installations will require public education
- ✓ Stopping sight distance of yield sign vs signals
- ✓ Pedestrian signals for visually-impaired pedestrians
- ✓ Disrupts traffic platoons

# What is a Roundabout

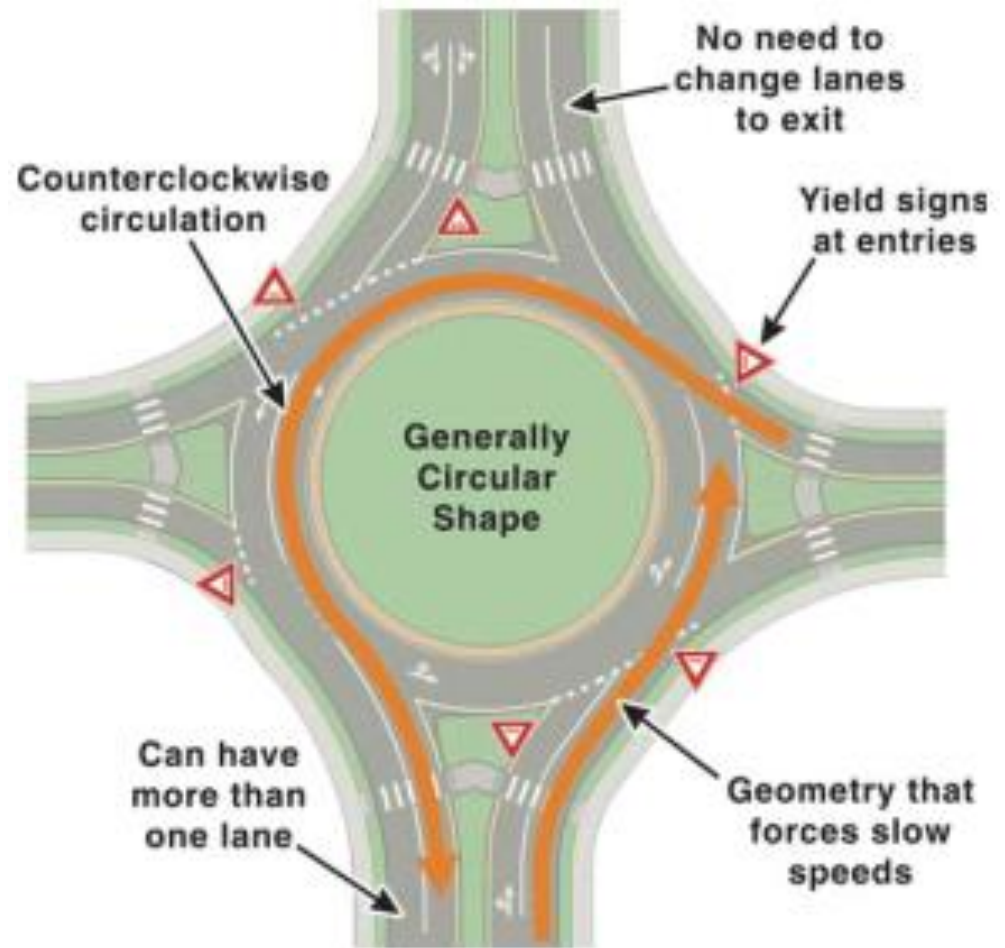
- ✓ A roundabout is a form of circular intersection in which traffic travels counterclockwise (in right-hand traffic countries) around a central island and in which entering traffic must yield to circulating traffic. *(taken from NCHRP report 672 Roundabouts: An Informational Guide)*
- ✓ Other circular intersections include Rotaries, Signalized traffic circles, and Neighbourhood traffic circles

# What is a Roundabout





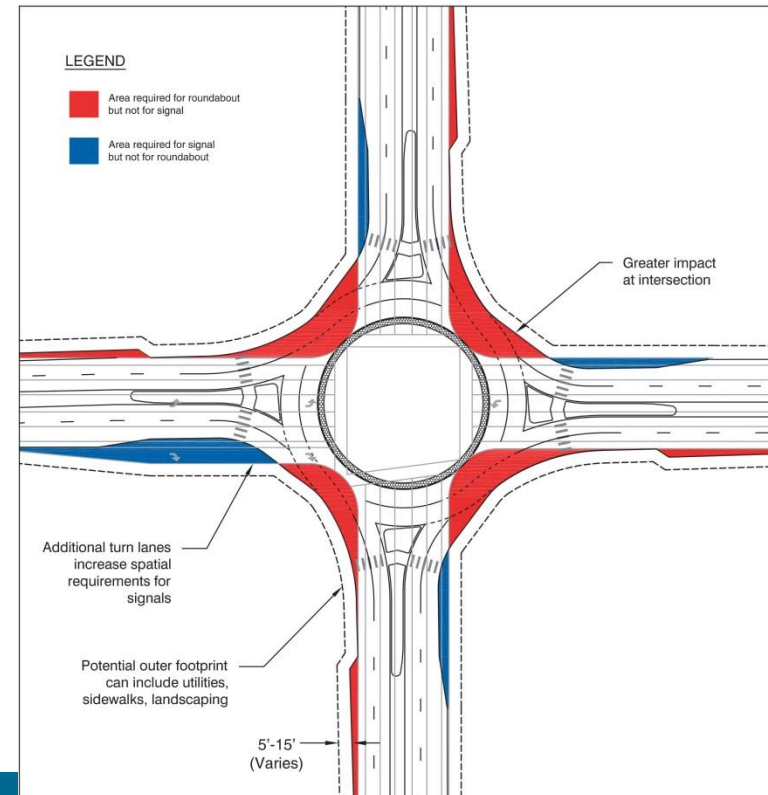
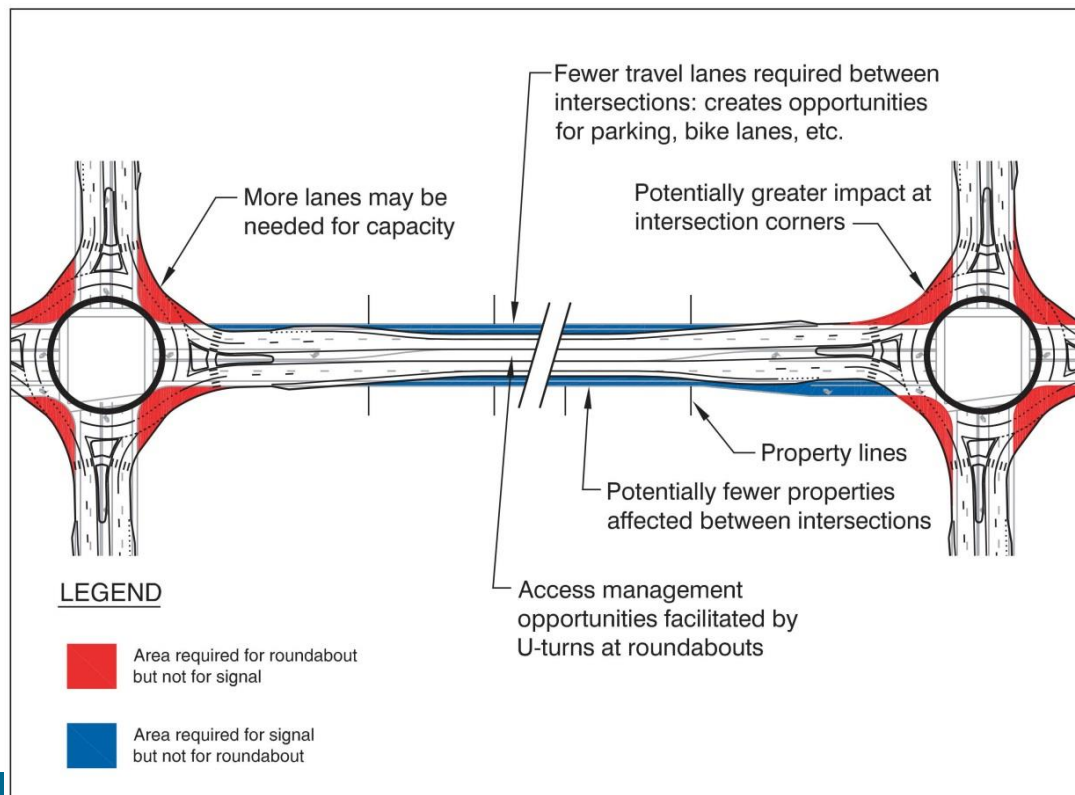
# What is a Roundabout



# When Should You Install a Roundabout?

# Roundabout Space Requirements

## “Wide Nodes Narrow Roads”



Engineers, Scientists, Surveyors

# Franklin Boulevard





# Policies



- ✓ Municipalities should ensure they have a formal policy endorsing roundabouts as an alternative intersection design.
- ✓ Some municipalities have taken a “Roundabouts First” approach, where roundabouts are considered the first option for an intersection treatment, with a rationale required as to why they are not used.

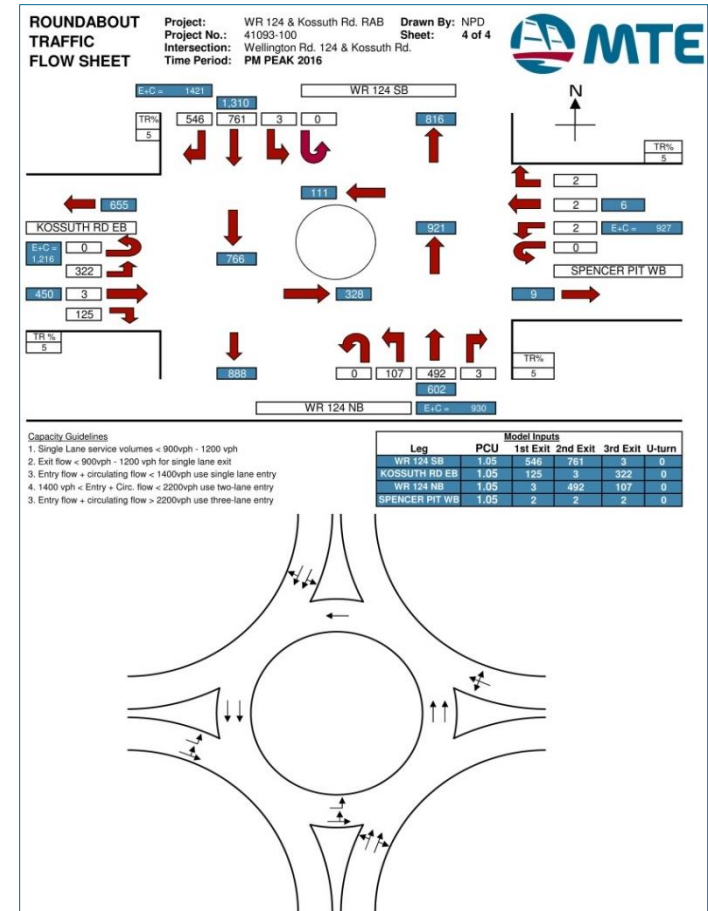
# Planning

- ✓ Initial Screening/Feasibility - provide a relatively quick assessment of the feasibility of a roundabout at a particular intersection in comparison to other appropriate forms of traffic control or road improvements
- ✓ Intersection Control Study – an in-depth analysis of the cost, property impacts and safety of alternative intersection control schemes at one or more study area intersections
- ✓ Traffic Impact Study (part of the development planning process)

# Justification for a Roundabout

# Intersection Control Study

- ✓ Detailed comparison of roundabouts to other forms of traffic control
- ✓ Traffic Flow Worksheet
  - Current traffic volumes
  - Projected volumes
  - Prel. lane configuration
- ✓ Operational Performance
- ✓ Life Cycle Costs
  - Construction/Properties
  - O & M
  - Injury Collision Cost





# Public Consultation/ Education



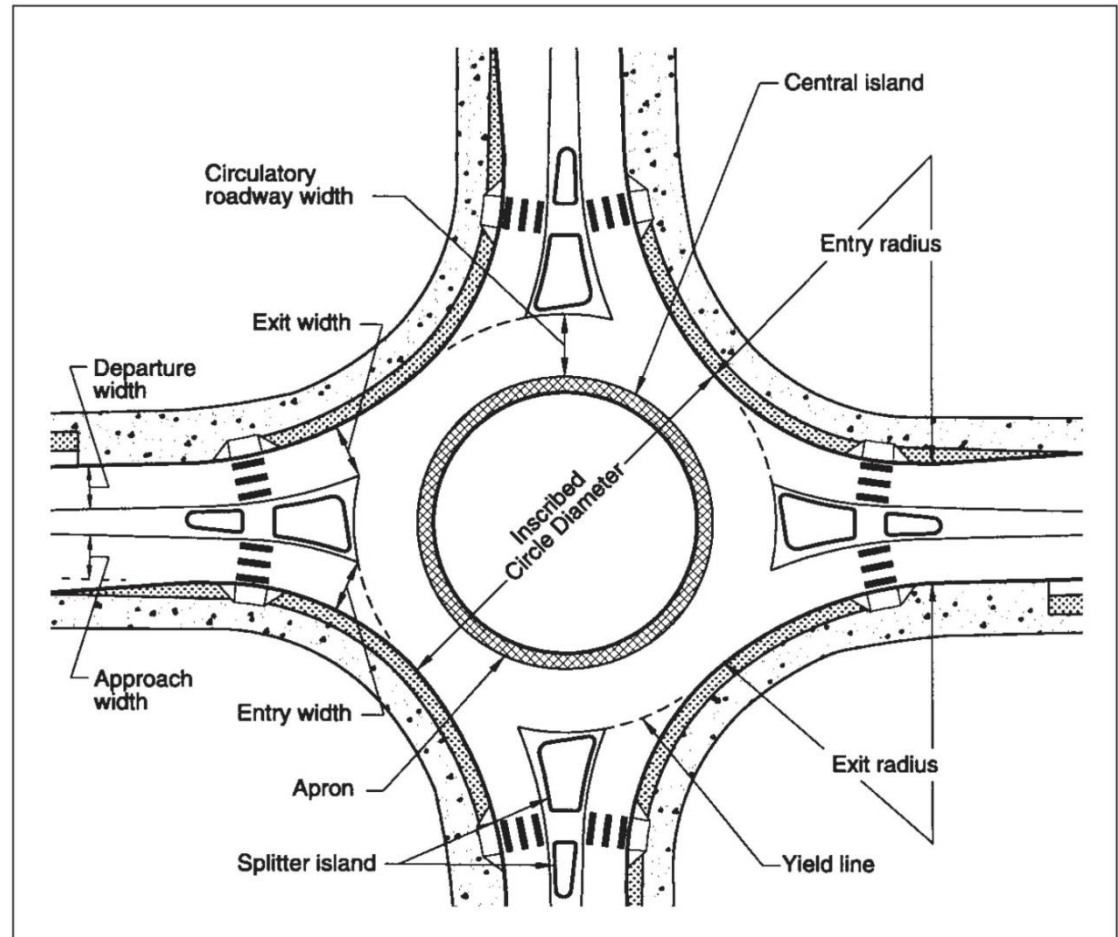
- ✓ Consultation, if required (project specific)
- ✓ Education (all roundabouts)
  - Websites
  - Mail-outs
  - Media Campaigns/Videos
  - Scaled models at meetings
  - Children's Safety Village
- ✓ Staff/Council
  - Visit roundabout sites (Road Trip)



# Key Components of a Roundabout

# Roundabout Geometry

- ✓ ICD (inscribed circle diameter)
- ✓ Entry Width
- ✓ Entry Radius
- ✓ Entry Angle
- ✓ Flare Length
- ✓ Circulatory Road Width
- ✓ Exit Width



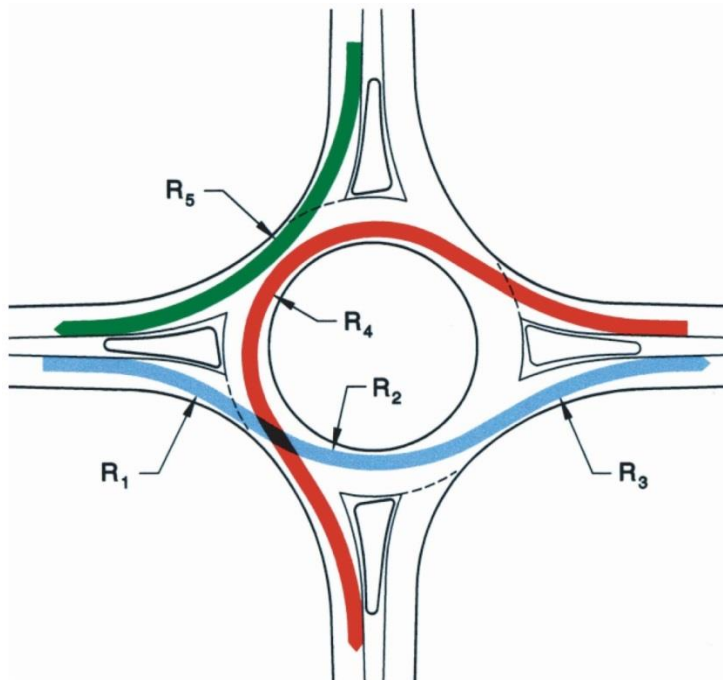
# Roundabout Design Principals



- ✓ Speed Management (Fastest Path, Deflection)
- ✓ Lane Numbers and Arrangements (Flow Sheet)
- ✓ Path Alignment (Path Overlap, Entry Deflection)
- ✓ Design Vehicle (Truck vs Bus, or site specific)
- ✓ Non-Motorized Users
- ✓ Sight Distance & Visibility

# Speed Management

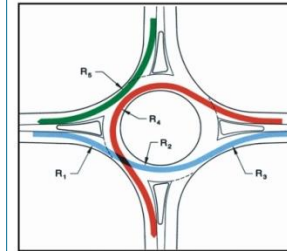
## Fastest Path



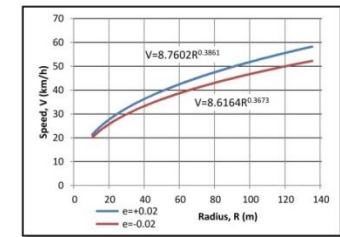
### ROUNDABOUT SPEED-RADIUS CALCULATIONS

Project: WR 124 & Kossuth Rd. RAB  
Project No.: 41093-100  
Intersection: Wellington Road 124 & Kossuth Road  
Date: December 21, 2017

Drawn By: NPD  
Sheet: 2 of 4



NCHRP Report 672, Figure 6-46



Speed-Radius Relationship

### KOSSUTH ROAD SB

Speed - Radius Calculations							Conflicting Speed Differentials		
	R1	R2	R3	R2+R4	R4	R5	Max. V	Min. V	Delta V
Accel. Distance (m)	-	-	-	45.6	-	-	-	-	-
Radius, R (m)	46.2	32.8	123.5	-	21.0	50.5	-	-	-
Speed, V (km/h)	38	34	56	60	28	40	43	28	15

### WR 124 EB

	R1	R2	R3	R2+A	R4	R5			
Accel. Distance	-	-	-	38.4	-	-	Max. V	Min. V	Delta V
Radius, R (m)	48.8	66.8	46.1	-	21.0	51.1	-	-	-
Speed, V (km/h)	39	44	38	64	28	40	48	28	20

### SPENCER PIT NB

	R1	R2	R3	R2+A	R4	R5			
Accel. Distance	-	-	-	49.0	-	-	Max. V	Min. V	Delta V
Radius, R (m)	61.3	47.7	116.7	-	21.0	43.8	-	-	-
Speed, V (km/h)	43	39	55	65	28	38	48	28	20

### WR 124 WB

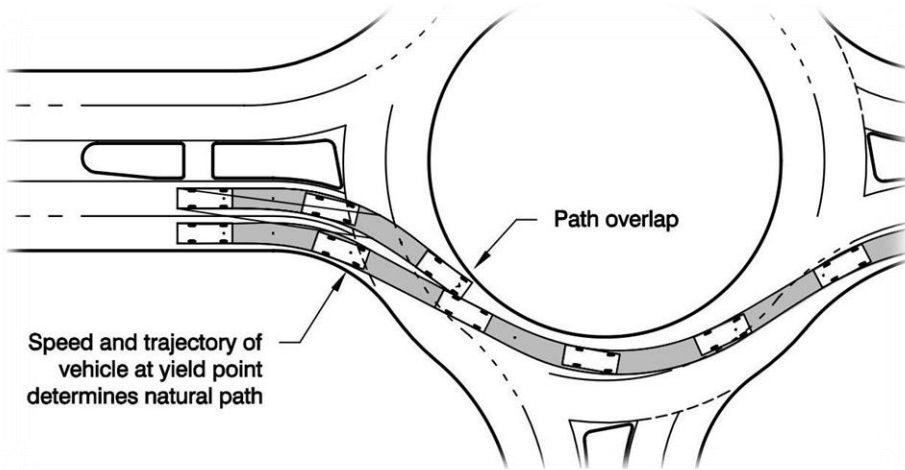
	R1	R2	R3	R2+A	R4	R5			
Accel. Distance	-	-	-	47.9	-	-	Max. V	Min. V	Delta V
Radius, R (m)	81.9	35.5	147.9	-	21.0	57.5	-	-	-
Speed, V (km/h)	48	35	60	62	28	42	48	28	20

#### Notes:

- Speed-Radius values were determined by offsetting from face of curb, not from edge of pavement or painted edge line.
- R2 and R4 values will differ depending on whether the circulatory road is crowned or adverse crossfall.

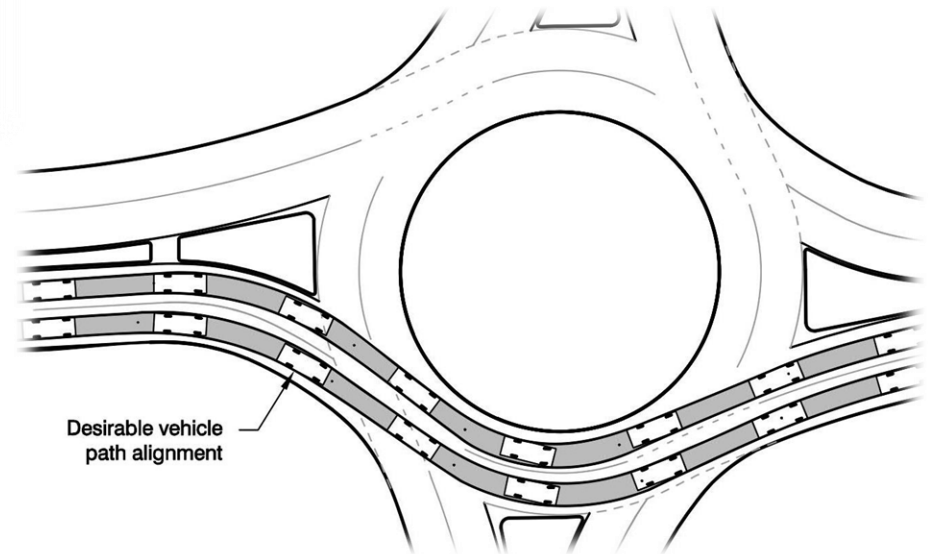


# Entry Design - Path Overlap



Desired Entry  
Curvature

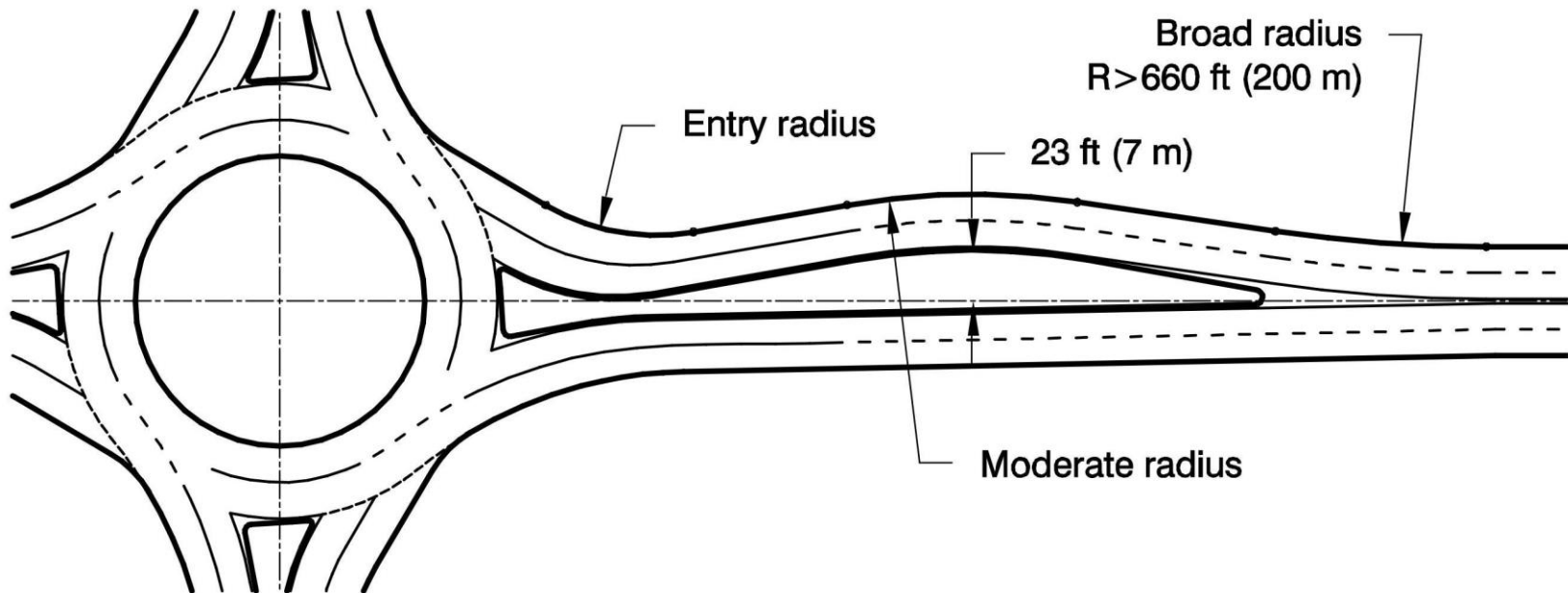
Poor Entry Curvature



Engineers, Scientists, Surveyors

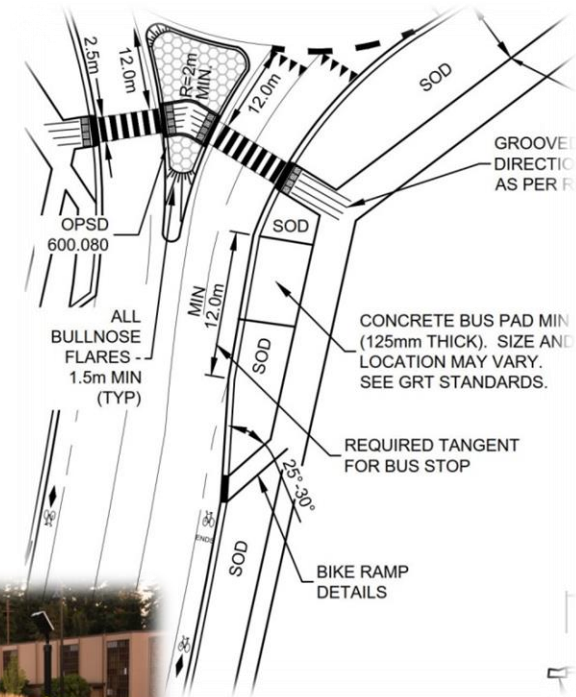
# High Speed Approach Curvature

The use of successively smaller curves on high-speed approaches can help slow traffic to an appropriate entry speed.



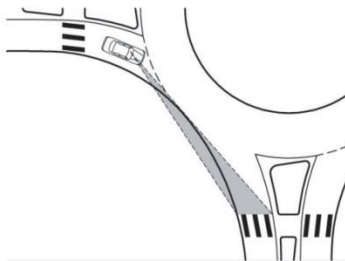
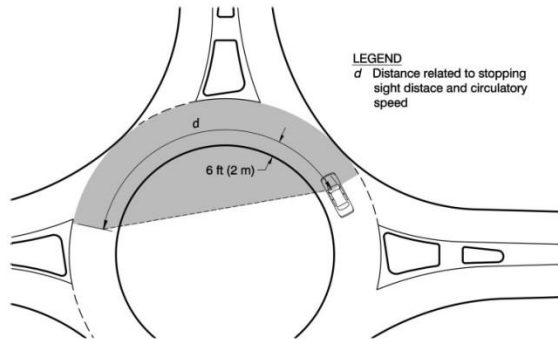
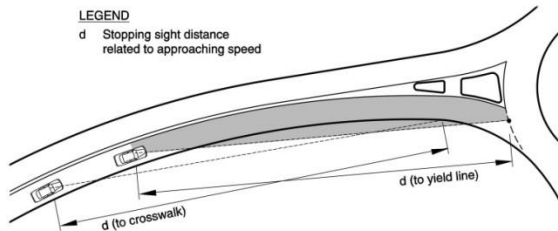
# Non-Motorized Users

- ✓ **Pedestrians**
  - Level 2 Crossing – Drivers must yield to pedestrians
  - Visually Impaired Users (RRFB – Rapid Rectangular Flashing Beacon)
- ✓ **Cyclists**
  - Multi-use trail exit/re-entry ramps
  - Or join traffic flow
- ✓ **Transit Stops**

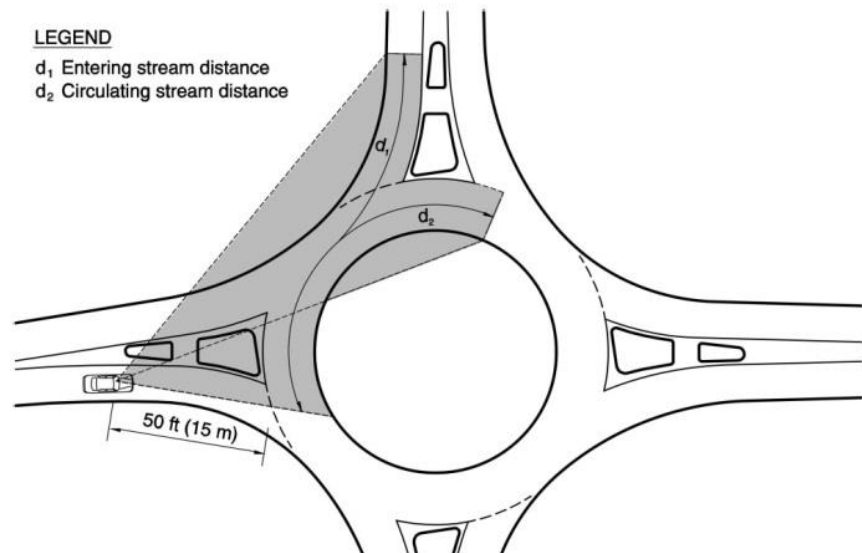


# Sight Distance

## Stopping Sight Distance



## Intersection Sight Distance



# Capacity Analysis



## ✓ Types of Models

- Empirical
- Gap-Acceptance
- Linear

## ✓ Analysis Software:

- Arcady
- Rodel
- Synchro/SimTraffic
- SIDRA
- Many others





# Design Checks

- ✓ Design Vehicle
- ✓ Entry Path Radius (Fastest Path), speed consistency
- ✓ Geometry
- ✓ Path Overlap, Entry Angles
- ✓ Sight Distances / Clear View Areas
- ✓ Pavement Markings
- ✓ Signage
- ✓ Pedestrian/Cycle/Transit Accommodations

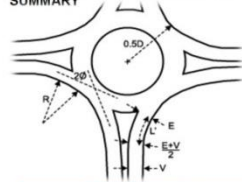
# Design Checks Package Sample



## ROUNDBABOUT GEOMETRIC DESIGN SUMMARY

Project: WR 124 & Kossuth Rd. RAB  
Project No.: 41093-100  
Intersection: Wellington Road 124 & Kossuth Road  
Date: December 21, 2017

Drawn By: NPD  
Sheet: 1 of 4



Design Parameters	SB	EB	NB	WB
Entry Width, E (m)	8.80	8.50	7.54	8.81
Effective Flare Length, L (m)	19.36	14.44	7.58	10.89
Road Half Width, V (m)	7.30	7.30	5.00	7.30
Entry Radius, R (m)	24.70	19.70	24.70	29.70
Entry Angle, $\theta$ (°)	13.42	10.41	18.31	13.04
Inscribed Circle Diameter, ICD (m)	58	58	52	58
Central Island Diameter (m)	39.00	39.00	39.00	39.00
Upstream Circle Road Width (m)	9.50	9.50	9.50	6.50
Exit Width (m)	6.66	10.29	6.31	8.40
Pedestrian Refuge Width (m)	5.73	4.90	2.39	4.72

Path Radius-Speed Parameters	SB	EB	NB	WB
R1 (km/h)	38	39	43	48
R2 (km/h)	34	44	39	35
R3 (km/h)	56	38	55	60
R4 (km/h)	28	28	28	28
R5 (km/h)	40	40	38	42
Delta V (km/h)	15	20	20	20

Minimum Sight Distance Parameters	SB	EB	NB	WB
Approach Design Speed (km/h)	80	80	80	80
Approach SSD (m)	139.6	139.6	139.6	139.6
Circulating (R2) SSD (m)	34.9	50.7	42.4	36.4
Pedestrian (R5) SSD (m)	43.7	44.0	40.5	46.8
Entering ISD (m)	60.0	48.1	49.2	53.7
Circulating ISD (m)	35.5	35.5	35.5	35.5

### Notes:

- Intersection sight distance (ISD) calculated based on 4.5s critical gap.

Additional Information	
Design Vehicle:	WB-20 for right turns and I-BUS for left turns (trucks use conc. apron for left turns.)
Circulatory Road:	Dual Lane (9.5m), Single lane (6.50m)
Truck Apron:	4.0m wide
Pedestrian Facilities:	2.0m Asph. on all legs, crosswalks with signs & zebra crosswalks provided on all legs
Bicycle Facilities:	Paved shoulder which taper out prior to pedestrian crossings
Other Comments:	None

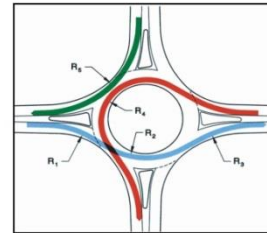
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1/3/2018

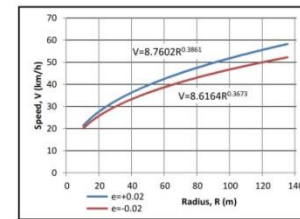
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NCHRP Report 672, Figure 6-46



Speed-Radius Relationship

### KOSSUTH ROAD SB

#### Speed - Radius Calculations

	R1	R2	R3	R2+A	R4	R5	Conflicting Speed Differentials		
Accel. Distance (m)	-	-	-	45.6	-	-	Max. V	Min. V	Delta V
Radius, R (m)	46.2	32.8	123.5	-	21.0	50.5	-	-	-
Speed, V (km/h)	38	34	56	60	28	40	43	28	15

### WR 124 EB

	R1	R2	R3	R2+A	R4	R5	Max. V	Min. V	Delta V
Accel. Distance	-	-	-	38.4	-	-	-	-	-
Radius, R (m)	48.8	66.8	46.1	-	21.0	51.1	-	-	-
Speed, V (km/h)	39	44	38	64	28	40	48	28	20

### SPENCER PIT NB

	R1	R2	R3	R2+A	R4	R5	Max. V	Min. V	Delta V
Accel. Distance	-	-	-	49.0	-	-	-	-	-
Radius, R (m)	61.3	47.7	116.7	-	21.0	43.8	-	-	-
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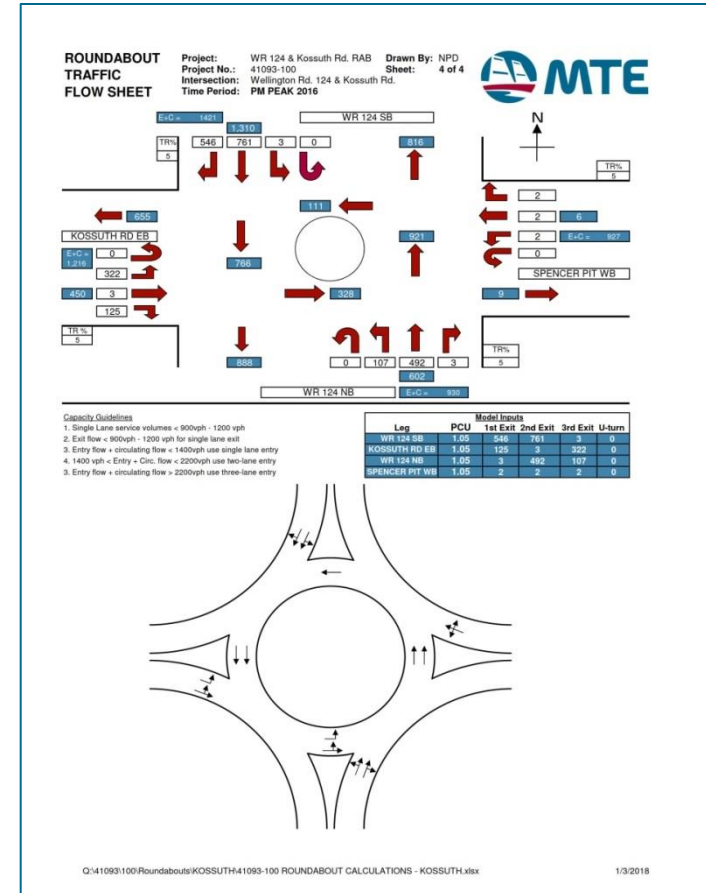
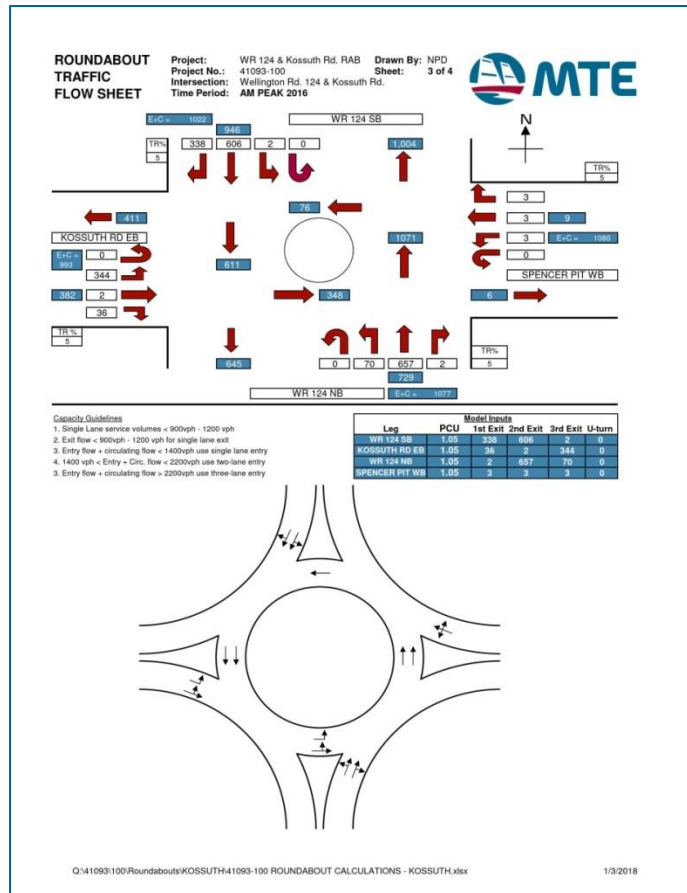
### Notes:

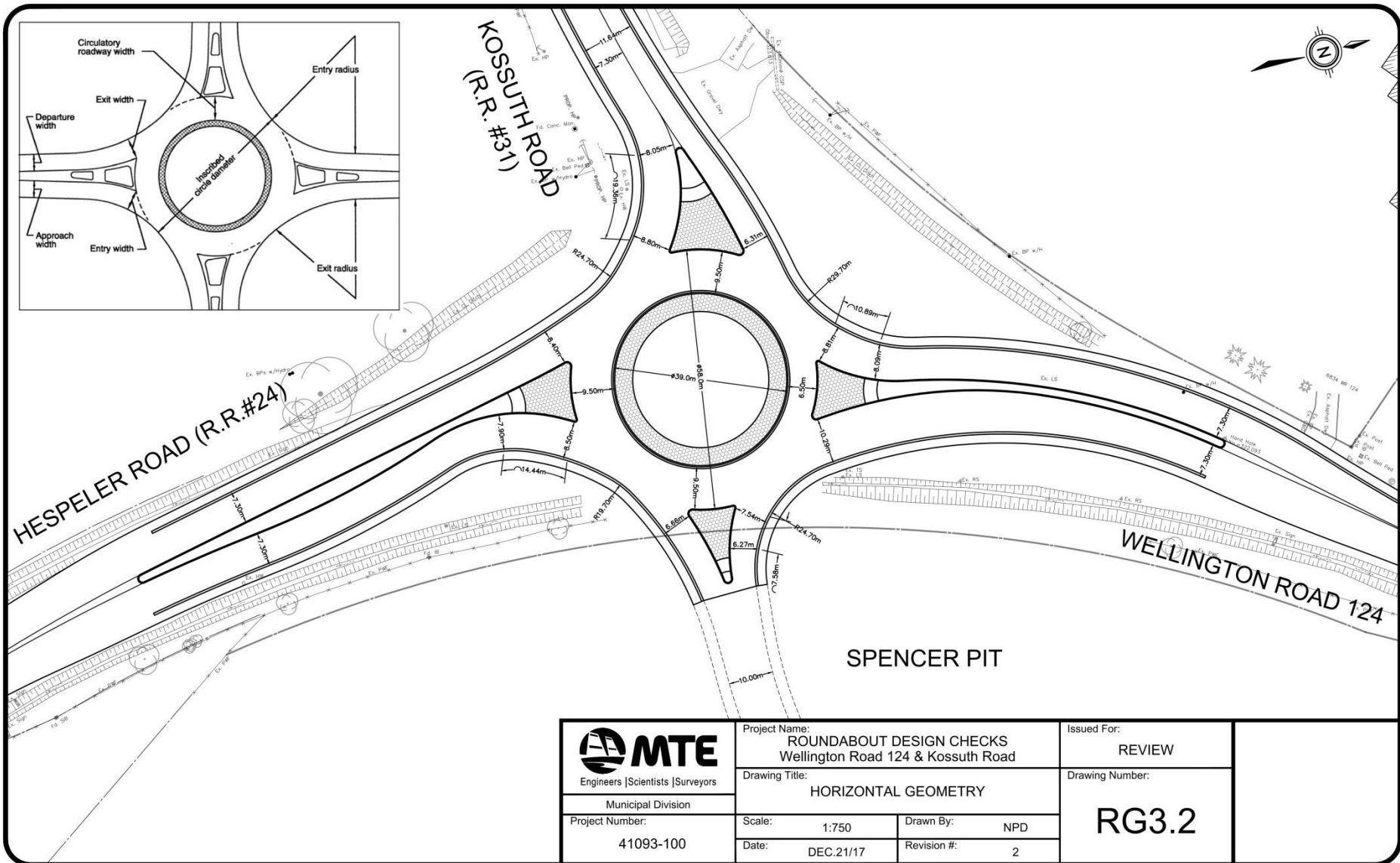
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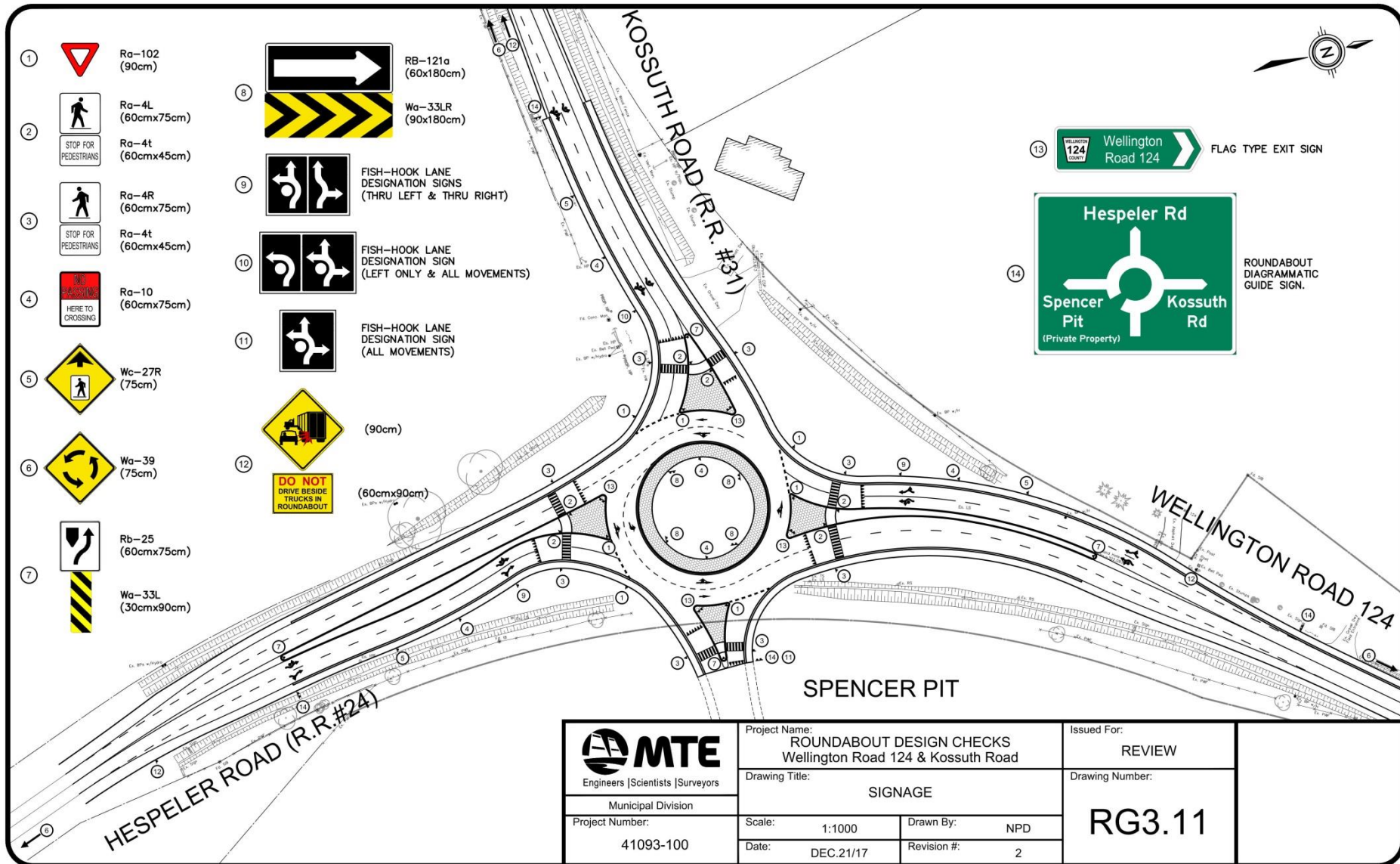
1/3/2018

# Design Checks Package Sample



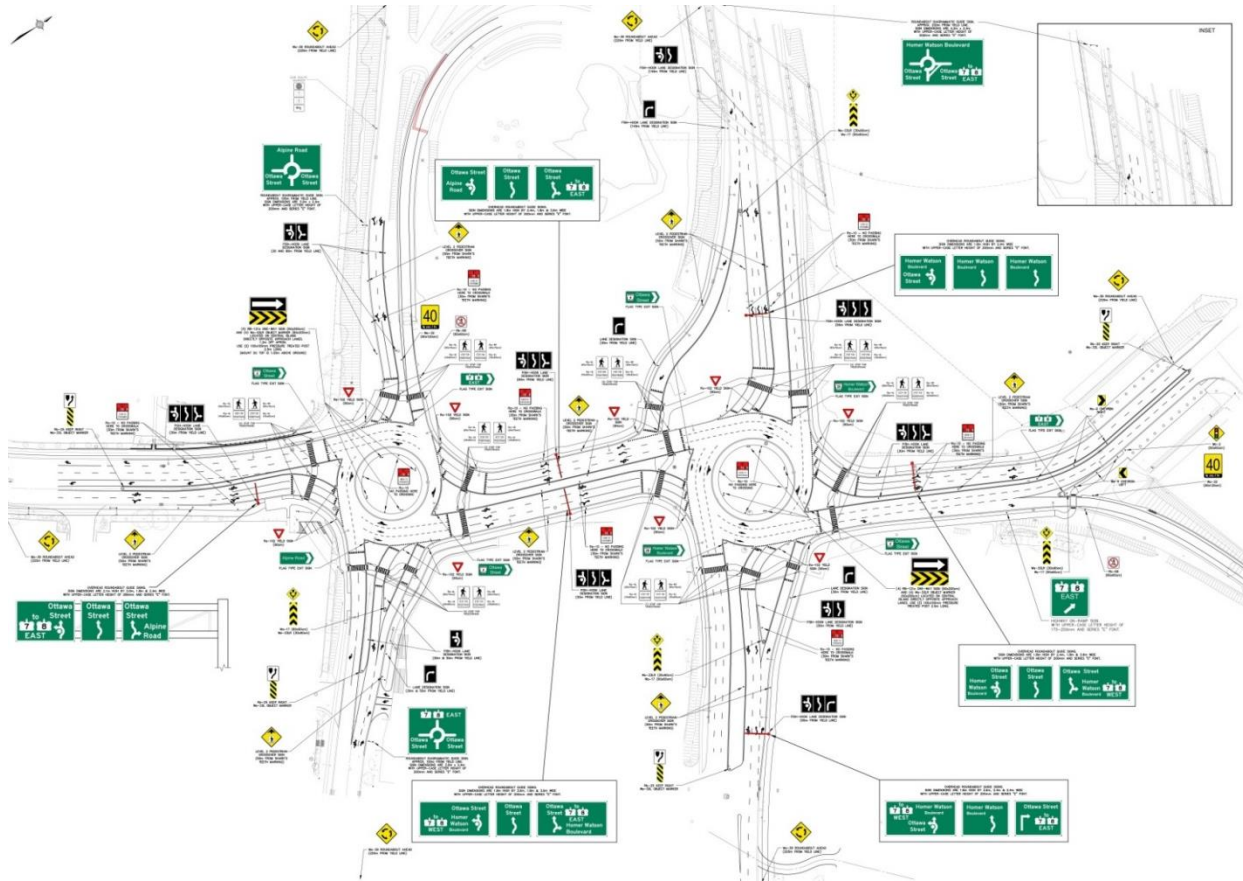






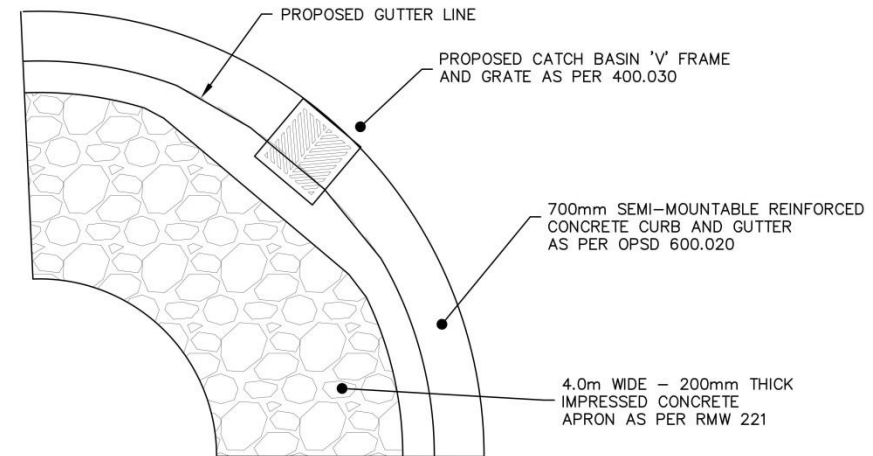
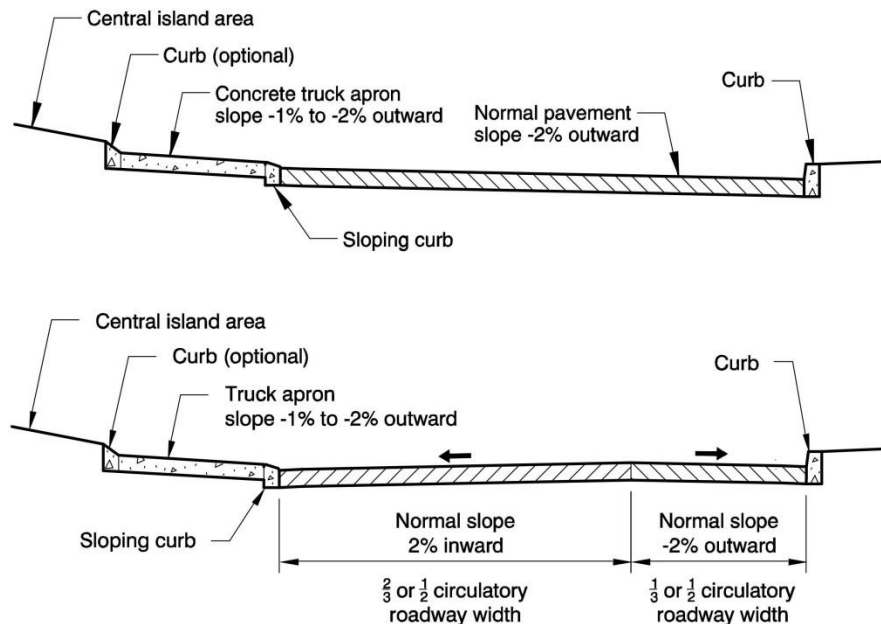


# Pavement Markings & Signage



# Detailed Design

- Grading - Sloped vs. Crowned Circulatory Roadways
- Storm Drainage Design
- Pavement Design



CATCH BASIN SETBACK DETAIL FOR  
ROUNABOUT CENTRE ISLAND  
N.T.S.

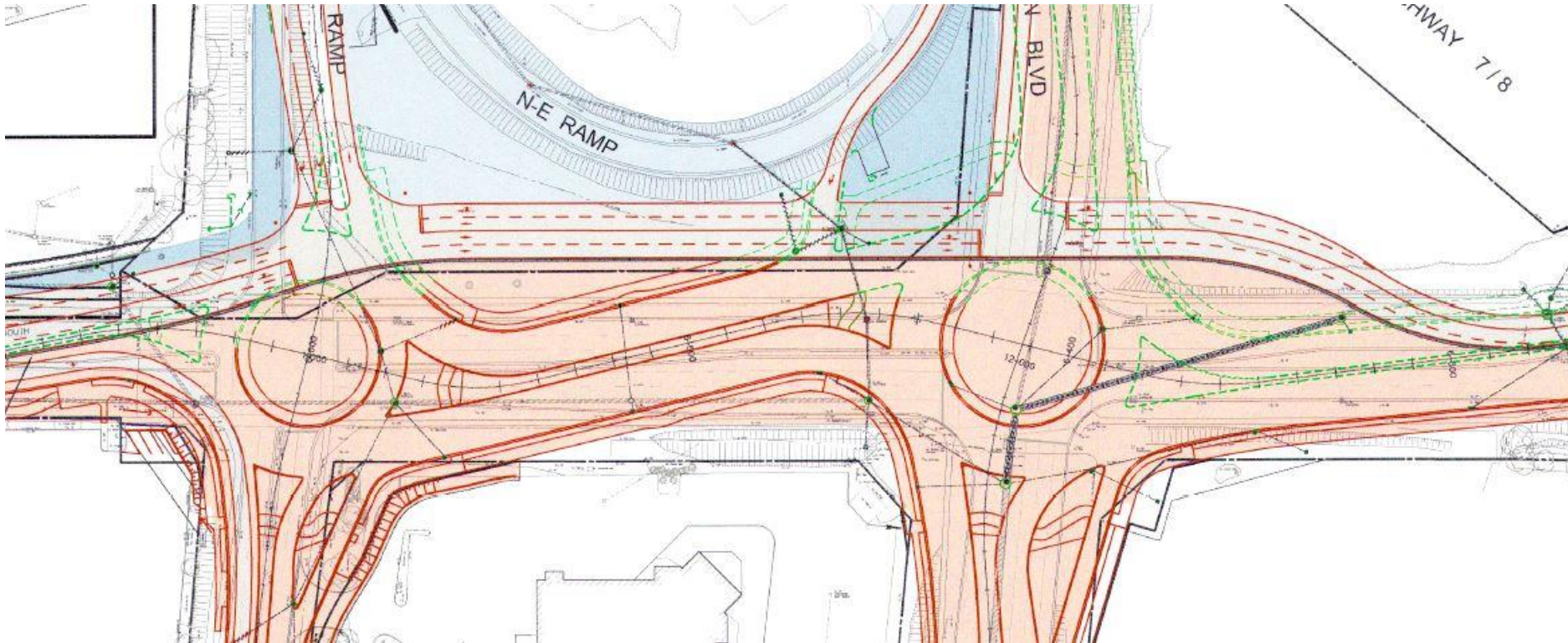
# Utility Relocations

- Hydro
  - Overhead Poles
  - Conduit/pull boxes
- Natural Gas
- Bell
- Fiber
- Cable
- Other



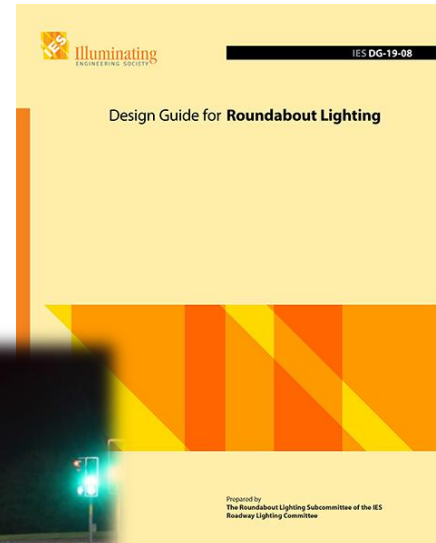


# Construction Staging



# Illumination

- ✓ Should conform to IESNA Design Guide for Roundabout Lighting (DG-19-08)
- ✓ Lamp type
- ✓ Pole location

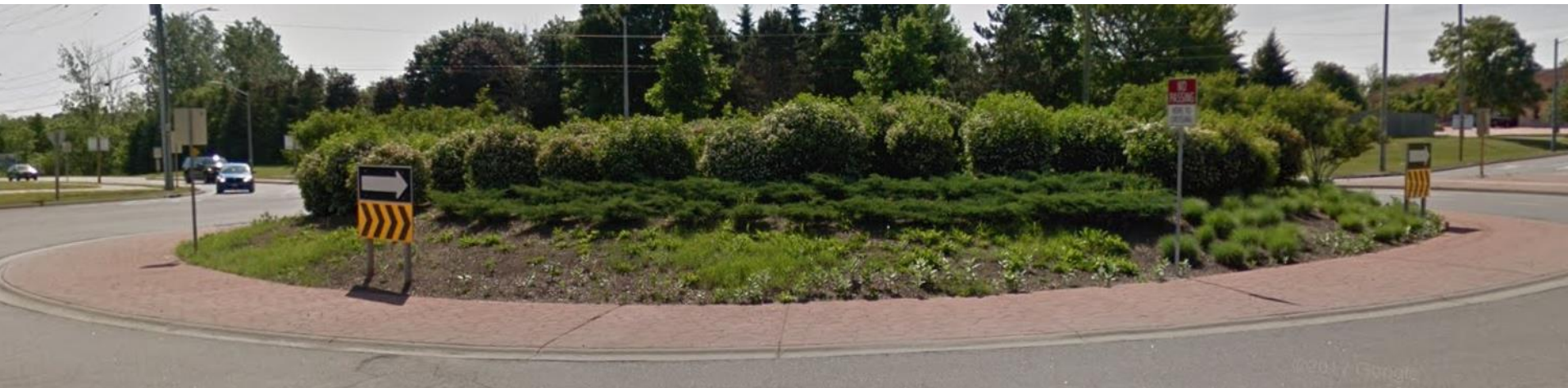




# Landscaping



- Landscaping height to follow sight distance restrictions
- Native, low maintenance, hose bib
- Hard features, such as retaining walls, large stones, public art, etc. are not recommended!



# Tender, Construction, Opening



- ✓ Specific traffic staging should be detailed in tender drawings
- ✓ Ideally traffic should not temporarily travel “wrong way” during construction staging;
- ✓ Usually do a soft opening as a single lane roundabout as one of the construction stages;
- ✓ If large enough, consider off-duty officers to help give a presence and enforcement (no tickets, just education).

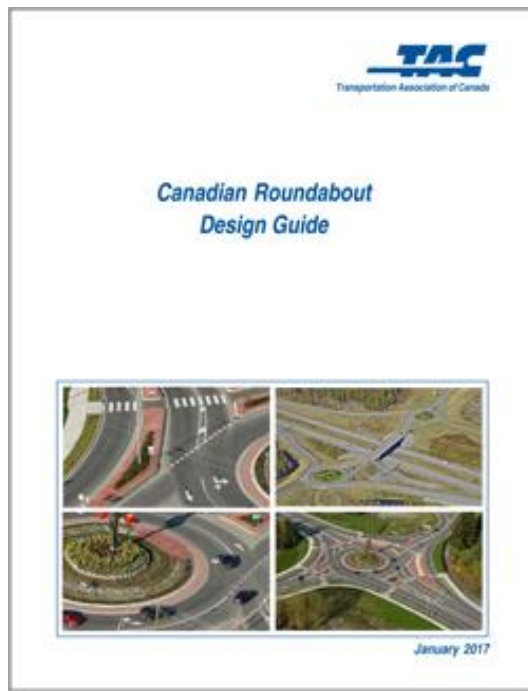
# Roundabout Maintenance

- ✓ Snow plowing
- ✓ Landscaping
- ✓ Hose Bib for watering/irrigation
- ✓ High quality road construction
- ✓ Sign maintenance important

# Design Guides / Manuals



- TAC: Canadian Roundabout Design Guide
- NCHRP Report 672: Roundabouts an Informational Guide
- NCHRP Report 572: Roundabouts in the United States



## NCHRP REPORT 672

**Roundabouts:  
An Informational Guide**

*Second Edition*

TRANSPORTATION RESEARCH BOARD  
OF THE NATIONAL ACADEMIES

NATIONAL  
COOPERATIVE  
HIGHWAY  
RESEARCH  
PROGRAM

In Cooperation with

 U.S. Department  
of Transportation  
Federal Highway  
Administration

## NCHRP REPORT 572

**Roundabouts in  
the United States**

TRANSPORTATION RESEARCH BOARD  
OF THE NATIONAL ACADEMIES

NATIONAL  
COOPERATIVE  
HIGHWAY  
RESEARCH  
PROGRAM

# Project Examples



# Ottawa Street Double Roundabouts





# Project Award



## CEO Award of Excellence



Engineers, Scientists, Surveyors

# Background

- Ottawa Street Corridor
- Collision Data
  - 376 Recorded collisions during EA Timeframe
- Corridor Congestion
  - MTO ramps
  - Fire truck
  - Transit route
- Safety measures



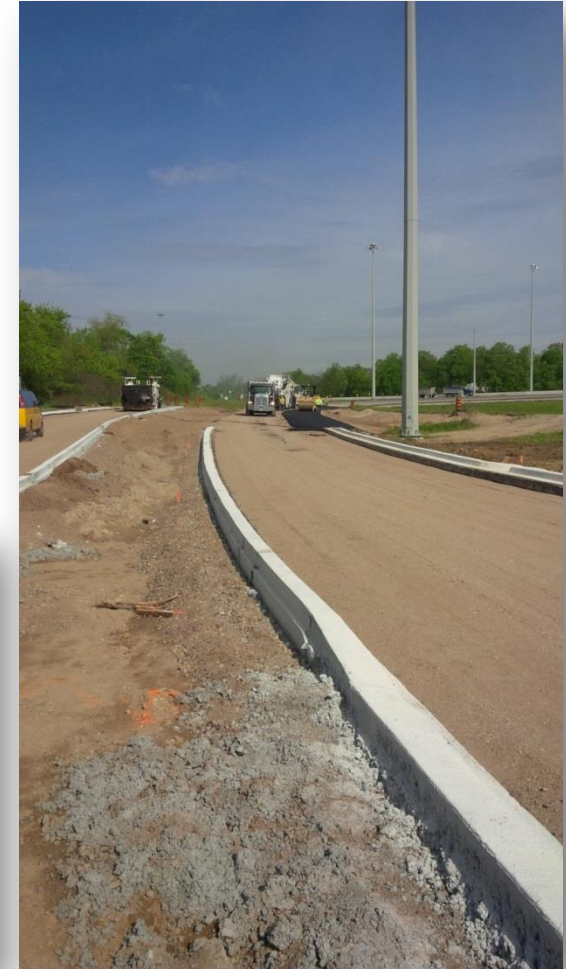


# EA Results: Preferred Alternatives



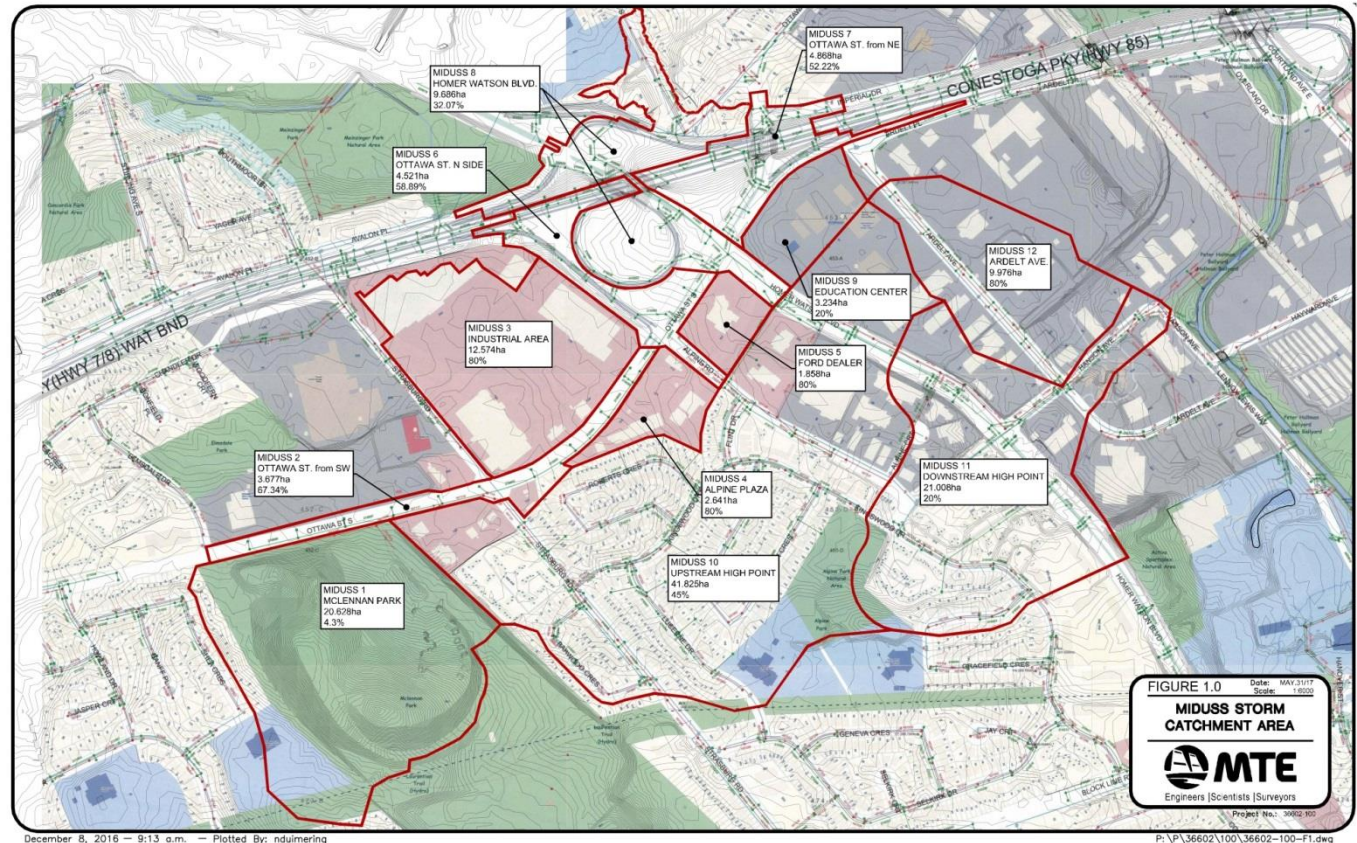
# MTO Ramps

- Ramp Realignments
- MTO Coordination
  - 30/60/90 Submissions
  - RIT Meeting
  - Encroachment Permit





# Storm Design



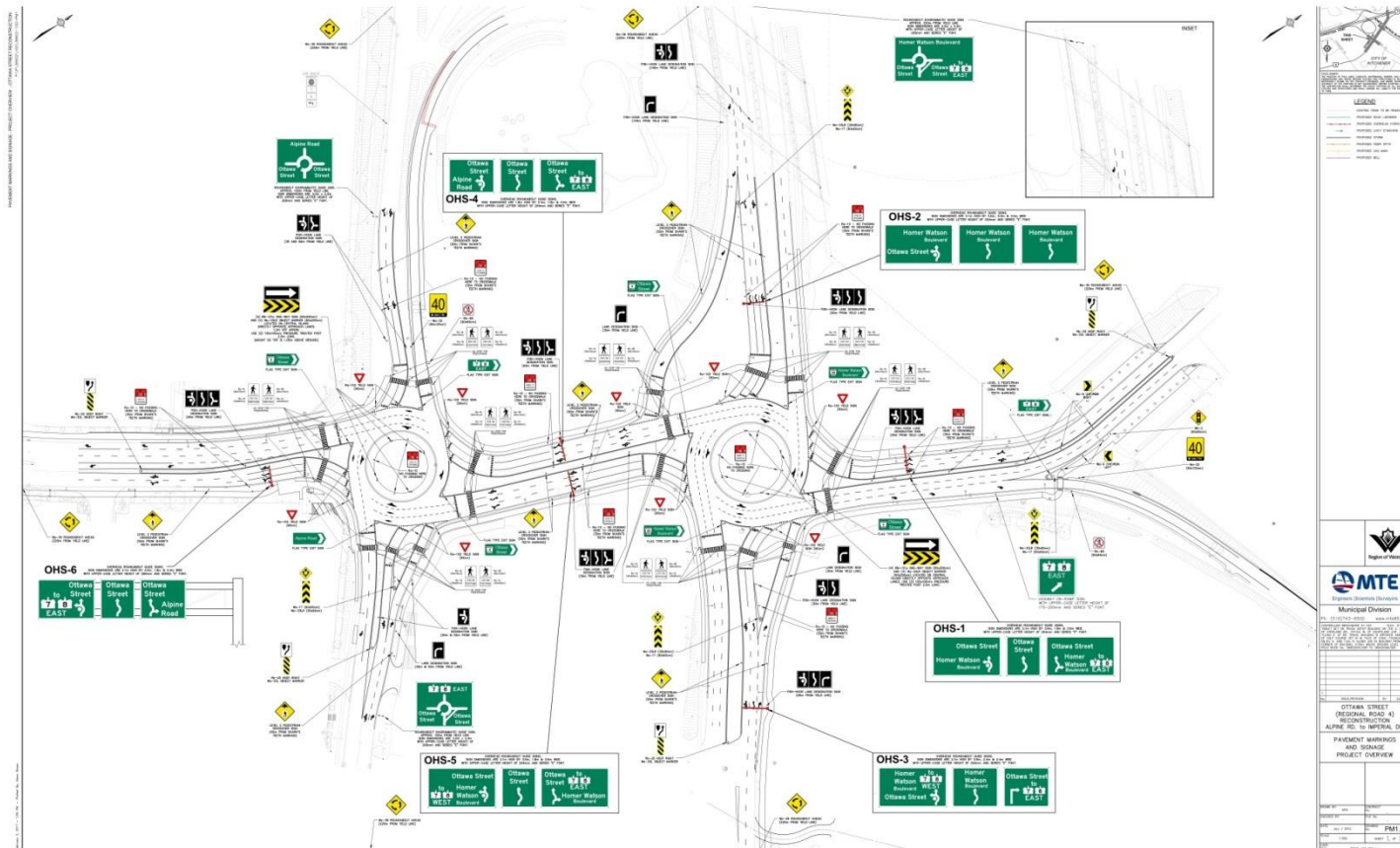
# Storm Design



AUG.25/16



# Pavement Markings & Signage



# Utility Relocations

- Bell relocation not complete after three years
- Gas main installation procedures incorrect, < 2 ft cover from FG



# Construction Challenges



## Utility conflicts

- \$40,000 Extra





# Construction Challenges



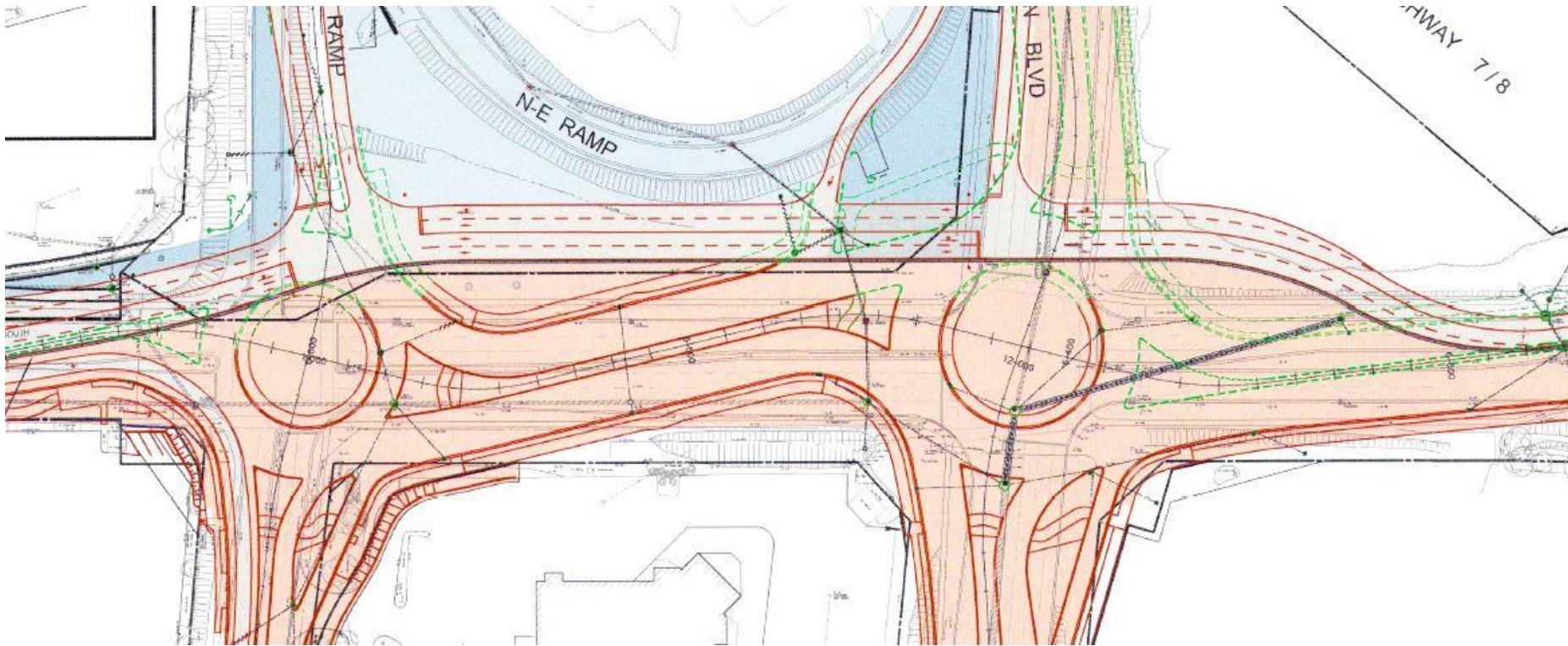
- Unstable peat layer
  - Re-stabilize drill rig pad



# Construction Staging

- Originally slated to be two-year construction
  - Social impact
  - Economical impact to businesses
- Ultimately completed in one year
  - Temporary road construction
  - Homer Watson Boulevard closure

# Construction Staging





# Construction Staging





# Construction Staging





# Construction Staging





# Construction Challenges



- Heavy Traffic
  - 55,000 vehicles per day
  - Nearby Fire Station HQ
  - Dangerous driving
  - Pedestrian traffic





# Ottawa St, Homer Watson Blvd, Alpine Rd; Kitchener





# Ottawa St, Homer Watson Blvd, Alpine Rd; Kitchener





# Ottawa St, Homer Watson Blvd, Alpine Rd; Kitchener





# Accident Photo



# Hespeler Road & Queen Street





# Ira Needles Boulevard & Erb Street West



# Rural Roundabouts

- Large farm equipment/horse & buggies
- High speed approaches:
  - High Landscaping
  - Longer splitter islands
  - Successive curves
  - Truck aprons
- Lighting
- Less accident severity



# Truck Apron



# Roundabout Ditch





# Hergott Road and Ament Line





# Hergott Road and Ament Line



Engineers, Scientists, Surveyors



# Kossuth Road and Wellington Road 124



# Kossuth Road and Wellington Road 124

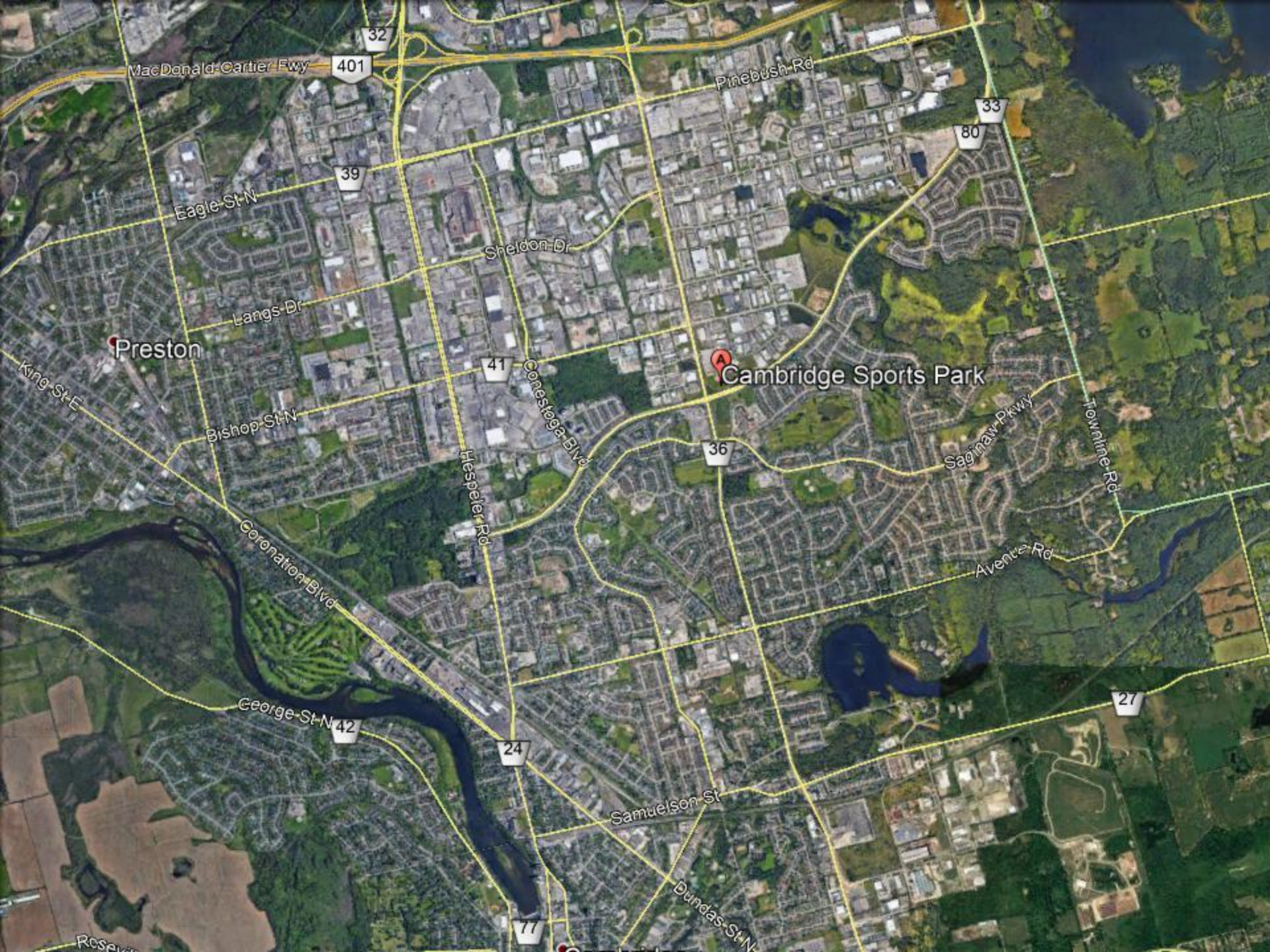




# Franklin Boulevard







MacDonald-Cartier Fwy

32

401

Pinebush Rd

33

80

Eagle St N

39

Sheldon Dr

Langs Dr

Preston

King St E

Bishop St N

41

Conestoga Blvd

36

Cambridge Sports Park

Saginaw Pkwy

Thompson Rd

Coronation Blvd

Hespeler Rd

Avenue Rd

George St N

42

24

Samuelson St

27

Dundas St N

Roseville



# Franklin Boulevard





# Franklin Boulevard



# Franklin Boulevard





# Bridgeport Bridge





# Bridgeport Bridge





# Bridgeport Bridge





# Bridgeport Bridge





# Bridgeport Bridge



# Questions

## Key Messages

- Roundabouts are safe
- Proper design is critical
- Think about constructability
- Think about maintenance
- Some locations better suited for roundabouts

