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# Assessing Value in Roundabouts vs. Signals - Highway 17/94/Centennial Crescent East Intersection

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## Topics

- Project Stages
- VE Study Set-up
- Information Phase
- What is the problem?
- Field Review Benefits
- VE Workshop
- Speed Management Measures  for Roundabout
- Safety Risk Analysis Contribution
- Independent Study Findings
- Roundabout Configuration
- Roundabouts  with high-speed approaches - Other locations
- Conclusion

# Project Stages

**Detail Design – February 2011**

- Resurfacing / Rehabilitation – approximately 12.8 km
- Improvements to Hwy 17/Hwy 94 – included in the project
  - No preliminary design

**VE Study - March 2011**

- Viable options for a Long term intersection solution

**Independent Study by a Roundabout Specialist - June 2011**

- Suitability of Roundabout
- Mitigation for high speed approaches

## Location Map


Roundabout under construction in Mattawa ~ 55 km east of the Highway 17/94/Centennial Crescent East Intersection

## VE Study Set-up

- Five-day  VE Workshop
- Independent team (16 members – including 6 MTO staff)
    - Highway safety Specialist /Roundabout Specialist
    - Traffic Engineer/Roundabout Specialist
    - Human Factor Specialist
    - Cost Estimator/Highway Engineer
    - AutoCAD/Highway Engineer
- All alternatives were developed using AutoCAD
- VE Estimator prepared costs for all alternatives to ensure consistency
- Followed standard MTO study plan with Fast Diagram, Project Risk Register as well as Performance Criteria & Measures

# Information Phase

**Highway classification**

Hwy 17 - King's Highway; RAU 110 km/h
Hwy 94 - King's Highway
Centennial Crescent - Municipal Road

Posted speed: Hwy 17 - 90 km/h, Operating speed – 99 km/h - 85 percentile – Speed Study 2010
Posted speed: Hwy 94 - 80 km/h
Centennial Crescent East- 60 km/h, West leg about 6 km apart

Growth forecast: 1.5%
AADT: 7,600
% of Commercial Traffic -11.6 / 2006 data

# Information Phase, Cont'd

**Hwy 17 – Wide Cross Section**

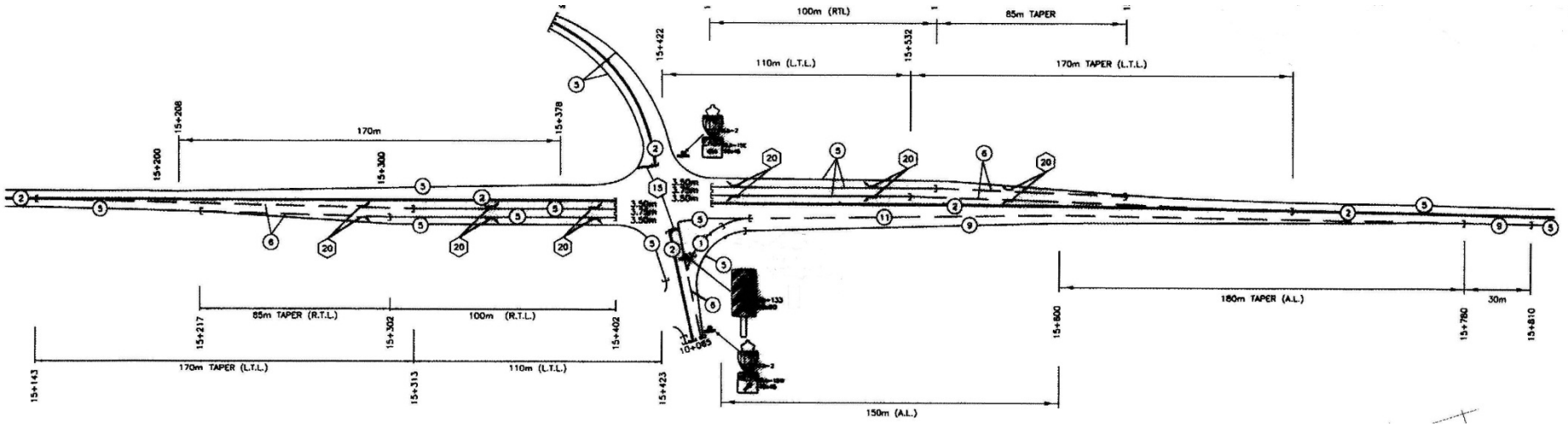
- Left turn lanes - EB and WB
- Through lanes
- Right turn lane – EB, Right Turn Taper – WB
- Vehicle accessing Hwy 17 from parking lot restricts visibility for Vehicle accessing Hwy 17 from Hwy 94

**Hwy 94**

- Shared left /through lane
- Channelized right turn
- Stop Control

**Centennial Crescent East**

- Shared left / through /right lane
- Stop control

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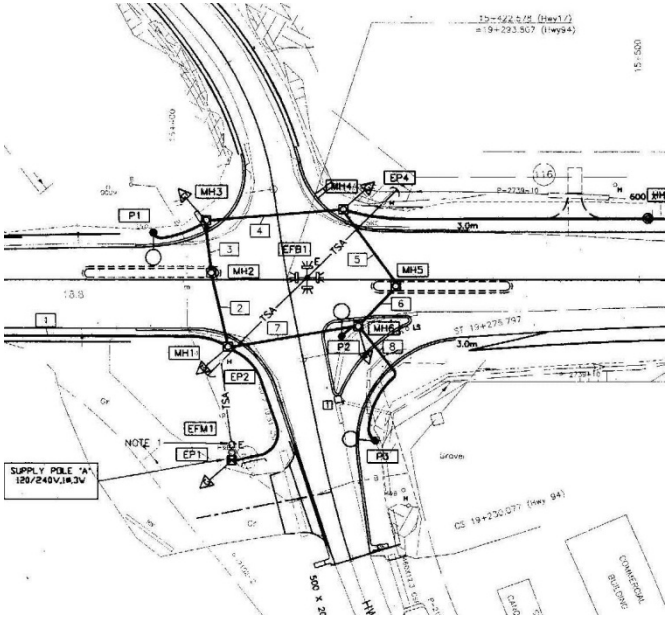
# Information Phase, Cont'd

## Existing Electrical

- Overhead flashing amber beacon installed
- Partial illumination - MTO owned:  3 poles
- Conduit installed in 2000 for future traffic signals



## Information Phase, Cont'd

### Vertical Alignment

- Flat grade at the intersection
- EB visibility of intersection limited by vertical alignment west of the intersection-hill

### Horizontal Alignment

- Hwy 17 - tangent
- Hwy 94 and Centennial Crescent East - curves approaching the intersection

### Existing Entrances

- Gas Station/Convenient Store - south east quadrant
- Chip Stand in the parking lot ~ 50 m from intersection- south west quadrant
- Residence\ businesses in the vicinity east north quadrant

## What is the problem?

- Municipality concerns- excessive speed at the intersections
- MTO speed studies for the intersection 1978/1999/ 2010 - speed is appropriate
- Turning  collisions predominant, severe collisions/injuries – point to operational problems
- Heavy left-turn movement from Hwy 94 to Hwy 17 W (Commuter Traffic) – unsatisfactory level of operation LOS F
- AADT increase - reduced gaps for minor roads entering major road during peak hours & conflicting movements.
- Traffic signals warranted due to volumes and delays at intersection - met combination criteria – Not installed due to concerns
- Outside peak hours adequate gaps available for minor street traffic

## Field Review Benefits

- Existing illumination pole creates blind spot  for Hwy 94 vehicles
- Vehicles on Hwy 94 advance beyond the stop bar at an angle to have better visibility


Hwy 94 looking east on Hwy 17

- Route Marker Sign  and TOD signs limit sightlines

Centennial Crescent looking east on Hwy 17

## VE Workshop

### Performance Criteria

*Constructability/Staging, environmental, safety and traffic Operations*

### *VE Proposals*

- **51 ideas - 13 VE proposals - 3 Scenarios developed**

## Scenarios

- Signalization with speed management – highest value solution – lowest cost
  - Double Long Distance Detection on EB and WB with speed management
  - Install advance warning sign and beacon on the WB approach/east of intersection
  - Change in collision frequency & severity associated with the introduction of signal control is minor
  - Slightly reduce right angle collision - Potential for run through red - non compliance - creates additional operational concerns.
  - Reduce delays for minor roads – increase delays for Hwy 17
  - 40% of Hwy 17 traffic will stop during peak hours –drop off during the day and significantly overnight
  - Speed management challenges
  - Low driver expectation of a new signalization - No signalized intersection ~ 155 km east of intersection - Deep River, 1.5 - 2-hr drive and ~ 10 km west of the intersection

## VE Workshop, Cont'd

- Roundabout with speed management – highest safety and operating performance for at grade option – higher cost
    - Safer - Decreases all collisions relative to signalized intersection
    - Collision severity reduced
    - Low peak-hour delays – average < 10 seconds – LOS A for all approaches
    - Continue to operate with high LOS well beyond the 2035 horizon year
    - 100% of Hwy 17 traffic slow down all day & about 5 -10% stop during peak hours
    - Public / trucking industry acceptance
    - Night time noise impacts

- Diamond Interchange – highest cost

## Speed Management Measures  for Roundabout

- Long splitter islands – informs drivers of the intersection ahead and creates "friction" to reduce operating speeds
- Transition to semi-urban cross section.  Outside (semi-mountable) curbs in advance of the entry to the roundabout and beyond the roundabout exit
- centre island design to block sightlines through the roundabout.  Grading and landscape planting  to increases visibility/awareness of the roundabout and block headlight glare from opposing vehicles on the offset approaches.
- Coloured textured surface truck apron can be used
- Full illumination to beyond the splitter islands on all approaches.
- curvilinear approach alignments.  Back to back curves to emphasize the intersection

## Speed Management Measures for Roundabout, Cont'd

- High visibility signage and markings:
  - "Roundabout ahead" signs with advisory or regulatory speed tabs well in advance of the intersection to allow for stepped speed reduction.
  - Flashing beacon and/or using an oversize sign to increase awareness
  - "Yield ahead" signs well in advance of the intersection.
  - Enhanced pavement markings approaching the intersection - wider edge lines
  - Keep right sign and object marker at end of splitter island.
  - Advance diagrammatic roundabout directional signs on approaches

## Safety Risk Analysis Contribution

### Stop Controlled (Existing ) Vs Signalized Intersection

- Change in collision frequency & severity associated with the introduction of signal control is minor
- Annual collision cost is about the same for stop controlled and signalized intersection with speed management
- Annual collision cost for a roundabout is substantiality less

### Signalized Intersection vs. Roundabout

- 76% reduction in injury when changing from signalized intersection to roundabout - *FHWA

* Federal Highway Administration (**FHWA**) is an agency within the U.S. Department of Transportation - *supports State and local governments in the design, construction*

# Independent Study Findings

Confirmed VE findings – Roundabout performs better in terms of safety and operations

**Signalization**

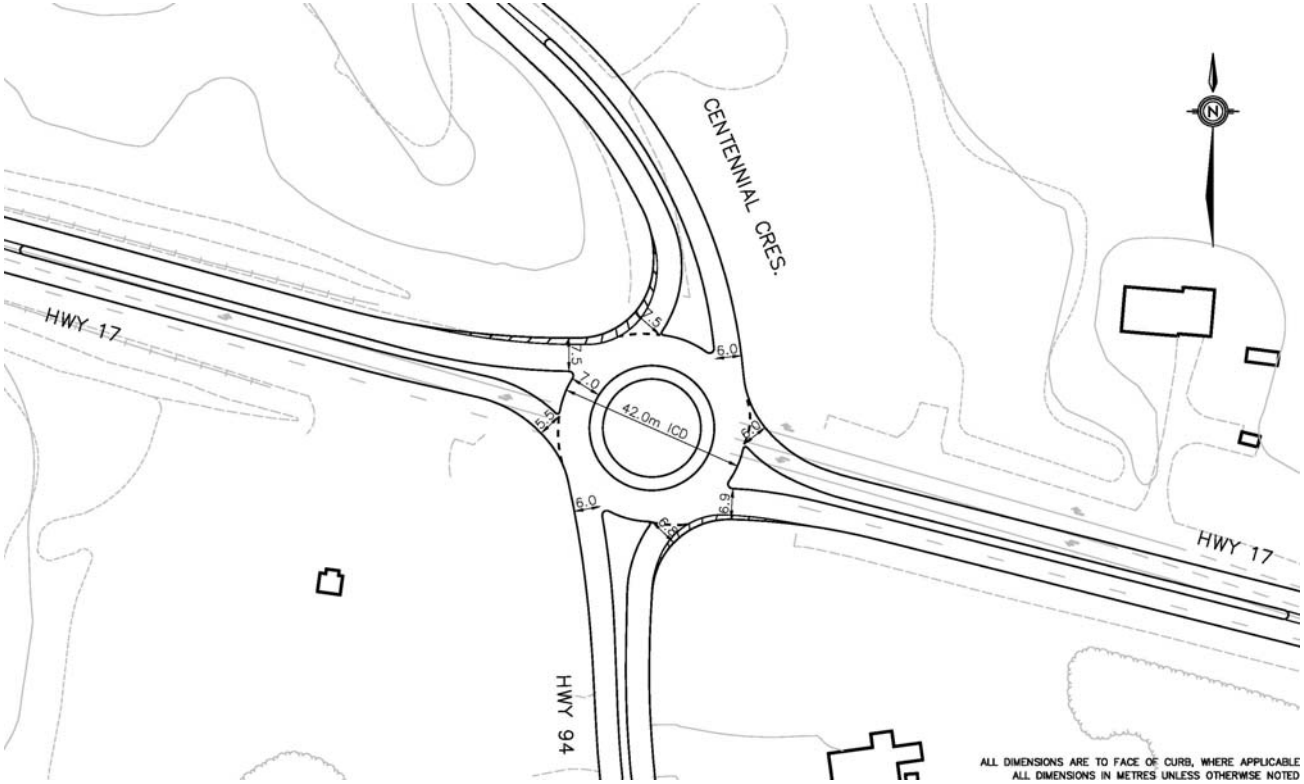
- Projected fatal + injury collision frequency – 0.7 collision per year if Intersection converted from stop condition to signalization
- Potential increase in rear-end collisions - 58% as per Highway Safety Manual
- Speed control treatments are required

**Roundabout**

- projected fatal + injury collision frequency - 0.29 collisions per year based
- Shorter delays and queues
- collision severity reduced
- Effective in reducing head-on and T-Bone collisions
- Speed control treatments more naturally lend themselves to implementation with roundabout

## Roundabout Configuration

- Single lane
- Diameter 43 m
- Speed at roundabout - 42km/h
- Truck apron
- Design Vehicle WB-20



## Roundabouts with high-speed approaches - Other locations

- *Hwy 26 at Wasaga Beach*
  - *Four-lane divided rural*
  - *90 km/ h posted speed*

- *Hwy 7 at St. Mary's*
  - *two-lane undivided rural*
  - *80 km/h posted speed ( 100 km/h operating speed)*

- *Hwy 406/East Main Street in Welland*
  - *at end of a four-lane freeway*
  - *100 km/h leading posted speed*

## Conclusion

- VE was used as an alternative to preliminary design to develop viable options for the intersection improvements
- VE accelerated the schedule by eliminating the preliminary design stage
- VE Team composition is important: Team included Roundabout specialist, Highway safety specialist, Traffic Engineer and Human Factor Specialist to address the intersection issue
- Road Safety Risk Analysis and Traffic Evaluation reports of the alternatives including existing condition are important
- Economic analysis should not be the only means of evaluation intersection control alternatives
- Introduction of new intersection control in high-speed context-not expected by drivers-will likely increase rear-end collisions
- Speed control treatments are required to enhance driver awareness
- Project Risk Register and mitigation measures were developed during the workshop were helpful
- VE provides the owner with the opportunity to make an informed decision based on either cost or performance without compromising the function.

## *Thank You*

## *Contact Information:*

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