Planning Process Overview

• Phase 1: Initial Screening
  - Quick assessment of feasibility of a roundabout vs other forms of traffic control based on order-of-magnitude life-cycle cost
  - Review of Screening Tool by Roundabout Coordination Committee (RCC) (Optional)
Initial Screening Tool Overview

- 5 page questionnaire designed to be completed in 3-5 hours
- Includes background information
  - Intersection location
  - Existing configuration/traffic control
  - Collision history
  - Forecasted traffic volumes
Initial Screening Tool Overview

- Includes proposed configurations for both roundabout and conventional improvements
  - Signals - #lanes, storage lengths, etc.
  - Roundabout – size, # of entry lanes, etc.
- Concept sketches of each config.
- 20-Year Life Cycle Cost Estimate
Initial Screening Tool Overview

WHAT A SCREENING TOOL IS NOT USED FOR:

- To compare safety performance
- To compare operational performance
- To determine property requirements of a roundabout
Screening Tool Guide

- Located in handout
- Information tips/sources are provided to assist proponent in filling out questionnaire
Screening Tool Question #9

Is the intersection located within a corridor that is scheduled for improvements in the 10 Year Transportation Capital Program? What is the ultimate cross-section of the approach roads?

**ARE ANY OF THE APPROACH ROADS SCHEDULED FOR WIDENING IN REGION’S 10 YEAR TRANSPORTATION CAPITAL PROGRAM?**

**CHECK WITH TRANSPORTATION PLANNING REPRESENTATIVE OR ACCESS CAPITAL PROGRAM ON REGION WEBSITE.**
Screening Tool Question #10

What is the collision history of the intersection over the past five years? Is there a collision problem that needs to be addressed?

**COLLISION PROBLEM TO BE DETERMINED BY TRANSPORTATION ENGINEERING.**
Screening Tool Question #13

If traffic control signals are being considered, are the traffic signal warrants met for the horizon year?

**BASED ON OTM WARRANTS.**

**WARRANT TO BE VERIFIED BY**

**TRANSPORTATION ENGINEERING**
Screening Tool Question #14

What size of roundabout is being considered for this intersection? (eg. Single-lane, two-lane entry or three-lane entry?)

Please attach a Traffic Flow Worksheet and lane configuration diagram. Please attach a sketch showing how a roundabout would “fit” into the right-of-way.

USE TRAFFIC FLOW WORKSHEET AND RODEL (OPTIONAL) TO DETERMINE NUMBER OF ENTRY LANES.
Screening Tool Question #14

**Typical Sizes:**

- **SINGLE – 40M INSCRIBED CIRCLE DIAMETER (ICD)**
- **2-LANE – 55M INSCRIBED CIRCLE DIAMETER (ICD)**
- **3-LANE – 70M INSCRIBED CIRCLE DIAMETER (ICD)**
Traffic Flow Worksheet

- Excel spreadsheet
- enter turning movements
- calcs circulating flows
- basic lane configuration

Capacity Guidelines:
1. Single Lane service volumes < 900 vph - 1200 vph
2. Exit flow < 900 vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400 vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200 vph use two-lane entry
5. Entry flow + circulating flow > 2200 vph use three-lane entry

<table>
<thead>
<tr>
<th>Leg</th>
<th>PCU</th>
<th>1st Exit</th>
<th>2nd Exit</th>
<th>3rd Exit</th>
<th>U-turn</th>
</tr>
</thead>
<tbody>
<tr>
<td>KING</td>
<td>1</td>
<td>40</td>
<td>760</td>
<td>370</td>
<td>0</td>
</tr>
<tr>
<td>KING</td>
<td>1</td>
<td>10</td>
<td>90</td>
<td>190</td>
<td>0</td>
</tr>
<tr>
<td>EAGLE</td>
<td>1</td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>0</td>
</tr>
<tr>
<td>EAGLE</td>
<td>1</td>
<td>420</td>
<td>80</td>
<td>70</td>
<td>0</td>
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</tbody>
</table>

REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET
VERSION 1.0 AUG 22, 2008

TRAFFIC
Worksheet
---Excel spreadsheet
---enter turning movements
---calcs circulating flows
---basic lane configuration
Traffic Flow Worksheet

STREET A

E+C = 2267

TR%  62  296  553  0

TR%  911  957

STREET B

E+C = 2,504

TR%  112

TR%  962

E+C = 0

2,504  1305

1199  972  115

STREET A

E+C = 2653

115

TR%  867

0  136  365  515

1016

STREET B

E+C = 2313

456

480  764  1700

0

2040
Traffic Flow Worksheet

Capacity Rules of Thumb:

- Entry + Circulating Flow < 1600 use single-lane entry
- 1600 < Entry + Circulating Flow < 2600 use two-lane entry
- Entry + Circulating Flow > 2600 use three-lane entry
E + C = 2267
GREATER THAN 1600 BUT LESS THAN 2600
THEREFORE USE A TWO-LANE ENTRY
Traffic Flow Worksheet

Determine Lane Configurations

- Each approach handled separately
- Add the turning movements on each approach
- Divide the total approach volume by the number of lanes
- Ensure balanced queuing and demand lane by lane by designating lanes as shared or exclusive
Traffic Flow Worksheet

Lane Assignment Calculation

- Sum the volumes: 62 + 296 + 553 = 911
- Divide the total by the number of lanes on the approach: 911/2 = 455
- 455 vehicles per lane results in even lane distribution and even queuing
- Determine what lane assignments are needed to apportion the turning flows to achieve 455 per lane
- Look for high right turns: Possible right-turn by-pass
Traffic Flow Worksheet

Lane Configuration Options

- RODEL assumes even distribution of vehicles into approach lanes and calculates queues based on this.

• HOW ABOUT THIS?

- OR THIS?
Traffic Flow Worksheet

Produce a Concept Sketch
Traffic Flow Worksheet
Example 2

Design Hour Volumes

STREET A
1262 500 53

STREET B
1100 568 480

STREET B
25 780 58

STREET A
250 340 37
Traffic Flow Worksheet

Example 2

E + C = 2903
GREATER THAN 2600
THEREFORE USE A THREE-LANE ENTRY
Traffic Flow Worksheet

Lane Assignment Calc. Example 2

- Sum the volumes: $1262 + 500 + 53 = 1815$
- Divide the total by the number of lanes on the approach: $1815/3 = 605$
- 605 vehicles per lane results in even lane distribution and even queuing
- Determine what lane assignments are needed to apportion the turning flows to achieve 605 per lane
Traffic Flow Worksheet
Example 2

Lane Configuration Options

• RODEL assumes even distribution of vehicles into approach lanes and calculates queues based on this

• IS THIS WHAT YOU WANT?
Traffic Flow Worksheet

Example 2

E + C = 2903

STREET A

E + C = 0

STREET B

E + C = 2,759

LESS THAN 2600

THEREFORE USE
A TWO-LANE ENTRY

REMOVE RIGHT TURNS USING A RIGHT-TURN BYPASS
Traffic Flow Worksheet

Lane Assignment Calc. Example 2

1262 BY-PASS 500 53

• Sum the volumes: 500+53 = 553
• Divide the total by the number lanes on the approach: 553/2 = 276
• 276 vehicles per lane results in even lane distribution and even queuing
• Determine what lane assignments are needed to apportion the turning flows to achieve 276 per lane

1262 BY-PASS 276 276
SHOW STORAGE LENGTHS FOR TURNING LINES
SHOW PROPOSED PROPERTY REQUIREMENTS
SHOW PROPERTY LINE 5m FROM EDGE OF PAVEMENT
Screening Tool Question #15

20-Year Life Cycle Cost Estimate

- Initial implementation cost
  - Construction
  - Property
  - Utilities
  - engineering

- Injury collision cost

- All costs are expressed in Present Value
## Screening Tool Question #15

### Initial Implementation Cost

**Traditional forms of Traffic Control**

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-WAY STOP INCL. FLASHERS</td>
<td>$25,000</td>
</tr>
<tr>
<td>TRAFFIC SIGNALS</td>
<td>$100,000</td>
</tr>
<tr>
<td>ADD LEFT-TURN LANE</td>
<td>$250,000</td>
</tr>
<tr>
<td>ADD RIGHT-TURN LANE</td>
<td>$150,000</td>
</tr>
<tr>
<td>MAJOR IMPROVEMENTS INCL. DUAL LTL'S, RTL'S, ADD'L THRU LANES, SIGNAL MOD., ETC.</td>
<td>$500,000-$1,000,000</td>
</tr>
</tbody>
</table>
## Screening Tool Question #15

### Initial Implementation Cost

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>SINGLE</td>
<td>$750,000</td>
</tr>
<tr>
<td>TWO-LANE</td>
<td>$1.2 MILLION</td>
</tr>
<tr>
<td>THREE-LANE</td>
<td>$1.8 MILLION</td>
</tr>
</tbody>
</table>
Injury Collision Cost

- Injury Collision Cost = expected # of injury collisions per year $\times 20$ years $\times$ $30,000$ (TAC)
- Existing intersection: expected collisions based on 5-year history
- New intersection: expected collisions based on collisions at similar Regional intersections
- Assumption: roundabout collision frequency is 50% of signals
20-Year Present Value
Injury Collision Costs

Existing Unsignalized Intersections
and
Future Intersections
Step 1 – Determine applicable injury collision rate

- Obtain 10-year horizon AADT, # legs
- Determine average injury collision rate from table

average injury collision rate at signalized intersections (injury collisions per million vehicles entering (Coll/MVE))

<table>
<thead>
<tr>
<th>AADT Entering</th>
<th>3-legs</th>
<th>4-legs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 5,000</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>5,001 to 10,000</td>
<td>0.09</td>
<td>0.15</td>
</tr>
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<td>0.07</td>
<td>0.12</td>
</tr>
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<td>0.12</td>
<td>0.16</td>
</tr>
<tr>
<td>20,001 to 25,000</td>
<td>0.11</td>
<td>0.16</td>
</tr>
<tr>
<td>Greater than 25,000</td>
<td>0.14</td>
<td>0.22</td>
</tr>
</tbody>
</table>
Step 2 – Determine expected annual injury collision frequency (AICF) for a proposed signal

\[ AICF = 365 \times \text{injury collision rate} \times \text{AADT} / 1000000 \]
Step 3 – Calculate 20-year present value (PV) injury collision cost for a proposed signal

\[
PV_{\text{signal}} = AICF \times ICC \left(\frac{(1 + i)^{20} - 1}{i(1+i)^{20}}\right)
\]

\[
PV_{\text{roundabout}} = PV_{\text{signal}} \times 0.50
\]

Where:

- **AICF** = annual injury collision frequency
- **ICC** = injury collision cost ($30,000)
- **i** = discount rate (6% or 0.06)
20-Year Present Value
Injury Collision Costs

Existing Signalized Intersections
Step 1 – Calculate existing injury collision rate for the intersection

- Determine total 5-year historical injury collisions
- Obtain existing AADT
- Calculate specific injury collision rate
- ICR = \( \frac{\text{5 yr. injury collisions} \times 1000000}{365 \times 5 \times \text{AADT}} \)
Step 2 – Compare injury collision rates

• Compare intersection specific rate to average rate
• Determine factor higher or lower than avg. rate

average injury collision rate at signalized intersections
(injury collisions per million vehicles entering (Coll/MVE))

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Step 3 – Determine expected injury collision rate (future)

- Obtain 10-year horizon AADT
- Reference 10-year horizon ICR from table
- Adjust ICR by factor higher or lower than avg.

Average injury collision rate at signalized intersections
(injury collisions per million vehicles entering (Coll/MVE))

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Step 4 – Determine expected annual injury collision frequency (AICF) for a signal (future)

AICF = 365 x factored injury collision rate x AADT / 1000000

average injury collision rate at signalized intersections
(injury collisions per million vehicles entering (Coll/MVE))

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</table>
Step 5 – Calculate 20-year present value injury collision cost

\[
PV_{\text{signal}} = \text{AICF} \times \text{ICC} \times \frac{((1 + i)^{20} - 1)}{i(1+i)^{20}}
\]

\[
PV_{\text{roundabout}} = PV_{\text{signal}} \times 0.50
\]

Where:

- AICF = annual injury collision frequency
- ICC = injury collision cost ($30,000)
- i = discount rate (6% or 0.06)
Working Example:

- Existing 4-leg signalized intersection
- Current AADT = 12,000 vehicles/day
- 10-year horizon AADT = 17,000 vehicles/day
- 4 injury collisions over past 5 years

Therefore:

\[
\text{AICF (current)} = 0.8 \text{ injury coll/year}
\]

\[
\text{injury collision rate (current)} = 0.18 \text{ compared to 0.12 injury coll/MVE (average)}
\]

\[
\text{injury collision rate factor} = 1.5
\]

\[
\text{injury collision rate (future)} = 0.16 \text{ (from table)} \times 1.5 \text{ factor}
\]

\[
= 0.24 \text{ injury coll/MVE}
\]
20-Year present value injury collision cost

\[
\text{AICF} = \frac{365 \times 0.24 \times 17000}{1000000} = 1.49 \text{ injury coll/year}
\]

and therefore

\[
\text{PV}_{\text{signal}} = \frac{\text{AICF} \times \text{ICC} \times ((1 + i)^{20} - 1) / i(1+i)^{20}}{\text{ }_{\text{signal}}}
\]

\[
= 1.49 \times 30000 \times ((1.06)^{20} - 1) / 0.06(1.06)^{20}
\]

\[
= $512,700
\]

\[
\text{PV}_{\text{roundabout}} = $256,350
\]
Recommendations and Conclusions

- Provide a recommendation to proceed to an Intersection Control Study (ICS) or not
- Briefly explain your rationale
Questions?