1. Call Meeting to Order
   Joe called the meeting to order at 12:02 PM. A boxed lunch preceded the business meeting. The total attendee count was 36. The breakdown was as follows:
   - 35 in-person attendees
   - 1 online attendee

2. Announcements
   Joe made the following announcements:
   - NCITE has created a new committee, the Younger Member Committee. It will operate in the same way as other existing technical committees.
   - The October NCITE Section Meeting will be on October 17 at the University of Minnesota. The presentation will be about the new Minnesota Crash Database.
   - Minneapolis was selected to host the 2018 ITE Annual Meeting! Preparations have begun to host the meeting.

3. Technical Presentation: Getting More Life from Old Diamond Interchanges
   Max Moreland introduced Denny Eyler from SRF to present on getting more life from old diamond interchanges.
   - It is important to try and get more life from old diamond interchanges since funding is limited and added capacity is often needed, it can improve safety at low cost, and innovative interchange designs can often use existing bridges.
   - There are 76 diamond interchanges with 4 or fewer lanes, through the bridge, in the Twin Cities Metro Area. Outer metro area interchanges were built in the 1960's and 1970's, where suburban development has occurred.
   - Some innovative interchange ideas include: roundabouts at ramp intersections, diverging diamond or double crossover diamond – DDI/DCD, diamond with added entrance loops or added inverted loops, lefts in advance and contraflow lefts, offset SPUI, 4 point diamond or ThrU-turn diamond, and unbalanced lanes.
   - A DDI was selected for the I-494 at 34th Avenue interchange. The right turns from the exit ramps have two lanes and are signal controlled. The DDI is run with one controller to assure coordinated pre-emption for LRT. Several other alternatives were tested including a SPUI, which was initially thought to be the answer by the City of Bloomington, but it would have required major reconstruction. The I-494 bridges would have had to be rebuilt and the grade changed either on I-494 or for 34th and the LRT line, in order to accommodate the deep girders required for the long bridge spans of a SPUI.
   - The I-494 at US 169 interchange used to be a diamond interchange. In the 1970's, a four level directional interchange with some local access was the proposed solution to the growing traffic demands. Money was tight, so only the new central bridges...
were built around the year 1980 to fit the future directional. The bridges had width for 3 lanes plus shoulders in each direction. The bridges were then striped in the interim to provide 2 through lanes and double lefts and the interchange continued for awhile as a diamond. In the 1990’s the loops were added as the north-south roadway became US 169 which later finally became a freeway. Recently, the interchange was rebuilt to a partial directional along with 3-½ diamond interchanges for local access and 6 roundabouts for local ramp intersections.

- The I-494 at County 9 diamond interchange were built in the 1960’s. The bridge has four lanes and no dedicated left turn lanes. Pedestrians are carried on a separate bridge along the south side. Several alternatives have been proposed and evaluated including roundabouts at the ramp intersections, conversion to a DDI, adding entrance loops and enhancing the existing design to be a 4-point diamond. The 4-point diamond design provides the most increased capacity at the least cost.

- Some recommendations when evaluating improvements to a diamond interchange include: have a long range view of the needs and your options, understand existing and forecast traffic, use planning level volume / capacity calculations for alternatives comparison, develop a range of alternatives, make sure the preferred alternative meet the project goals, don’t build the wrong thing to standards, consider maintenance issues, and consider signing requirements.

4. Adjournment
Max thanked the speaker and adjourned the formal business meeting at 12:50 PM.

Respectfully submitted,

Scott Poska
Date: October 13, 2016

2016 NCITE Secretary
Getting More Life from Old Diamond Interchanges

NCITE Meeting

Dennis Eyler, P.E., P.T.O.E.
Principal - SRF Consulting Group, Inc.
Minneapolis, MN

September 27, 2016
Why this Topic?

- Funding is limited and added capacity is often needed
- Safety can also be improved at low cost
- Innovative interchange designs can often use existing bridges
- Existing diamonds can often be improved

- It’s a follow-up to 2003 ITE presentation – *Getting More Life From Old Cloverleaf Interchanges*
Candidate Diamonds

- 76 diamond interchanges with 4 or fewer lanes, through the bridge, in the Metro Area
- Which old diamond locations are likely to need added capacity?
  - Outer metro area locations built in the 1960’s and 1970’s, where suburban development has occurred
  - Rural locations with major traffic generators
    - Truck stops
    - Outlet Malls
    - Exurban commuting concentrations
Traffic operations people try to keep all the plates spinning

Others (you know who you are) would just like to stop and glue one plate and declare “At least that one is fixed…. forever”
Benefits vs Costs

Traditional Graph of B/C Relationship

Benefits

Costs

“Optimal” point
But What Often Happens

Striving for “perfection”

Added maintenance and added replacement costs and funds diverted from other needs

Let’s embrace “practical design”
Goals for this Presentation

• Show designs where existing bridges were used for innovative interchanges – CONCEPT IMPROVEMENTS
• Show modifications to existing diamond interchanges – TACTICAL IMPROVEMENTS
• Discuss signal design and timing issues
• **Fire your imagination**
“Innovative” Interchanges

• Roundabouts at ramp intersections
• Diverging diamond or double crossover diamond – DDI/DCD
• Diamond with added entrance loops or added inverted loops
• Lefts in advance and contraflow lefts
• Offset SPUI
• 4 point diamond or ThrU-turn diamond
• Unbalanced lanes
Alternative Interchange Examples

Roundabouts

DDI

Added Entrance Loops

Added “Inverted” Entrance Loops
DDI Examples

TH 101 at 141st

I-494 at 34th
Added Entrance Loop Examples

I-494 at France

I-94 at Weaver Lake Road
Added Inverted Entrance Loops
Examples

I-494 at E. Bush Lake Rd.
Alternative Interchange Examples

Displaced Lefts

“CFI Diamond”

Lefts in Advance

“DDI + through”

Contraflow Lefts
Alternative Interchange Examples

Offset SPUI

MN 36
Alternative Interchange Examples

4 Point Diamond

Photo from USGS
Alternative Interchange Examples

• Cross street through traffic moved to a new bridge – I-94 at CSAH 30 in Maple Grove
Alternative Interchange Examples

Today
CONCEPT LEVEL IMPROVEMENT
PROJECT EXAMPLES

1. Diamond converted to DDI
2. Unbalanced lane use through underpass
3. Long term evolution of a diamond to a partial directional interchange
4. A pending project demonstrating the development and evaluation of alternatives
Example 1 - I-494 at 34th Avenue
Bloomington, MN

MSP Terminal 2
Previous Diamond

LRT with 16 trains per hour

34th Avenue

Several peak flows per day
Heavy exit ramp lefts in AM with queues onto I-494
Heavy lefts outbound in PM
Very low through to through N-S traffic
I-494 at 34th Avenue
Alternatives Considered
SRF developed the concept and prepared the funding request. Kimley-Horn Prepared the final construction plans with SRF assistance.
## I-494 at 34th – Screening Matrix

<table>
<thead>
<tr>
<th>Alternative or Concept</th>
<th>Existing Diamond</th>
<th></th>
<th>Diverging Diamond</th>
<th></th>
<th>SPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1a</td>
<td>1b</td>
<td>2</td>
<td>2a</td>
<td>3</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>Inverted Entrance Loops</td>
<td>Inverted South Loops</td>
<td>Base Layout*</td>
<td>SB to EB Flyover</td>
<td>Base Layout</td>
</tr>
<tr>
<td><strong>ROW Required:</strong></td>
<td>Minimal</td>
<td>Minimal</td>
<td>---</td>
<td>Minimal</td>
<td>---</td>
</tr>
<tr>
<td><strong>ROW Sensitivity:</strong></td>
<td>Low</td>
<td>Medium</td>
<td>---</td>
<td>Low</td>
<td>---</td>
</tr>
<tr>
<td><strong>Construction Cost:</strong></td>
<td>$48</td>
<td>$51</td>
<td>$6</td>
<td>$29</td>
<td>$65</td>
</tr>
<tr>
<td><strong>Construction Impact:</strong></td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td><strong>2030 V/C (AM/PM):</strong></td>
<td>0.95 / 0.71</td>
<td>0.92 / 0.75</td>
<td>0.88 / 0.77</td>
<td>0.83 / 0.61</td>
<td>1.05 / 1.06</td>
</tr>
</tbody>
</table>
Before
Example 2 - I-35 at Co Rd 50
Lakeville, MN

Issues

Short ramp (420’) with heavy left turn volume, queues onto freeway

Close in frontage road

Heavy directional flows

More development planned for area

Underpass with 3 total lanes – overpass had just been re-decked
The Result - Diamond With Unbalanced Lane Use

- Ramp length increased with striped gore
- Dual left from exit ramp
- Frontage Road Cul-de-sac
- New westbound roadway behind side piers

North
I-494 at Dakota Co. Rd. 50

Photos by D Eyler

trail

Westbound

Eastbound
Example 3 - 494 at US 169

Taking the Long View

1960’s - diamond with one way frontage roads. The cross street was a county road, but would later become US 169; and a freeway.

Photo from USGS
I-494 at US 169
Diamond with Added Loops

Around 1980 – bridges rebuilt to fit ultimate interchange, diamond operation continued

1990’s – 3 loops added to increase capacity, maintaining local access was an issue. US 169 to the south was being rebuilt to a freeway.
I-494 at US 169

Partial Directional Interchange Plus Local Access

2013 – Partial directional interchange built with local access via 6 roundabouts - Existing bridges from 1980 were used
Example 4 - I-494 at County Rd 9 Pending Project

Existing County Rd 9

850 ft.

Signal

600 ft.

4 Lane bridge
No left turn lanes

600 ft.

Separate pedestrian bridge

Weave
I-494 at County Rd 9 - Alternatives

Roundabouts at Ramp intersections

Add Loops

Enhance Existing

DDI
I-494 at Co Rd 9
4 Point or ThrU-turn Diamond

2 phase ½ signal
Lefts (U-turns) have FYLTA

3 phase signal
With RT overlap

Different from “traditional 4 point - Entrance ramps remain at current location
ThrU-turn Intersection

ThrU-turn “loon” based on design vehicle

Tight signal coordination will be required

2 phase ½ signal
Lefts (U-turns) have FYLTA
ThrU-turn 4 Point Interchange
Schematic
Fernley Nevada
# I-494 at CSAH 9
Alternatives Evaluation (2013 volumes)

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Year 2035</th>
<th>Volume to Capacity Ratios</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>AM Peak Hour</td>
<td>PM Peak Hour</td>
</tr>
<tr>
<td>Existing Diamond</td>
<td></td>
<td>0.94</td>
<td>0.90</td>
</tr>
<tr>
<td>Existing With Enhancements</td>
<td></td>
<td>0.87</td>
<td>0.81</td>
</tr>
<tr>
<td>4 Point – ThrU-turn Diamond</td>
<td></td>
<td><strong>0.72</strong></td>
<td><strong>0.63</strong></td>
</tr>
<tr>
<td>Diamond with 2 lane Roundabouts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W Ramp</td>
<td>0.69</td>
<td>0.89</td>
<td>1.7</td>
</tr>
<tr>
<td>E Ramp</td>
<td>0.80</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>DDI – 2 X 2 – bridge widening?</td>
<td></td>
<td>0.64</td>
<td>0.76</td>
</tr>
<tr>
<td>Rebuilt Diamond – new bridge with 7 lanes</td>
<td></td>
<td>0.53</td>
<td>0.49</td>
</tr>
<tr>
<td>Diamond w/ 2 loops</td>
<td></td>
<td>0.50</td>
<td>0.54</td>
</tr>
<tr>
<td>SPUI – rebuild interchange</td>
<td></td>
<td>0.51</td>
<td>0.51</td>
</tr>
</tbody>
</table>

**Note:** Capacity (1.00) = crit ln vol of 1400 = LOS “D”
Evaluation Procedure

• Compare existing volumes to forecasts
  – Make sure any traffic in queues is also counted
  – Understand key assumptions in the forecasts

• Develop alternatives – use Alternative Intersection Selection Tool (AIST) and your imagination
  – Include just geometric and signal improvements
  – Include the “full” build alternative for comparison

• Find out where you can’t go

• Perform capacity analysis – critical lane or CAP-X

• Develop rough cost estimates, consider costs to maintain traffic during construction
SOME TACTICAL IMPROVEMENTS
Queue detection

Extend detector

Steady yellow

Flash yellow

Proceed on flashing ONLY

Maryland SR 100 at Snowden River Parkway
Channelized right to entrance ramp creates more gaps for opposing permitted left turns,

Channelized right from exit ramp creates weaving issue and view angle is poor – replace with dual right with overlap phase signal control or un-displayed phase.
Right Turn Issues

Avoid introducing free flow elements into a pulsed flow environment.
If the upstream signal is green, then gaps are few.
If the upstream signal is red then you don’t need a free flow entry.

For this type of weave you should have 7 to 10 seconds per lane change.
Here the speed is 55 mph and 3 lanes need to be crossed. The first downstream left should be ½ mile away. Here it’s 1300 feet.
In Need of Tactical Improvements

- Shoulders, but no left turn lanes
- Left turns must yield to right turns
GRTA is not displayed during phase 4

There are other options depending on pedestrian treatment; and for a channelized right, an un-displayed phase can be used.

The one car that made a left on phase 4

Long delay for this car
Right Turn Overlap

Opportunity for RT overlap phase, but through traffic should be in left lane
In Need of Tactical Improvements

Double left, but no auxiliary lane through ramp intersection. High left turn volume concentrates in left through lane.
Auxiliary Through Lanes

Auxiliary through lanes connecting to ramp turn lanes
Unbalanced Lane Use

I-494 at 12th Ave. So.
Summary of Geometric Options

- Convert shoulders to driving lanes
- Exit ramp dual left and right turn lanes
- Auxiliary inbound lanes connecting to far side left turn lanes
- Auxiliary lanes in bound through adjacent intersections connecting to turn lanes
- Unbalanced lane use
A traffic signal is a device for a traffic engineer to leave their intelligence at an intersection to operate it in their absence.

- Matthew Huber
Diamond Signal Operations

• One controller or two?
  – If two controllers, how is coordination achieved without a master controller?
  – Today’s controllers can talk to each other and form a virtual single controller
  – If ramp intersections are less than 7 seconds apart one controller may still be best

• Phase order, lead or lag?
  – Less than 450 feet, lead light; lag heavy
  – Over 450 feet; lag, lag
New controller software can make two adjacent controllers into a virtual single controller. This provides the benefits of a single controller with:

- The reliability and fail-safe feature of two cabinets
- The ability to use standard cabinets

Real time data collection and performance evaluation
Needed Features

- Software that uses volume level switching to:
  - Turn on and of FYLTA
  - Enable or delete overlaps
  - Enable alternative barrier offsets
  - Prohibit RTOR
This is a new development in controller architecture, if using a single controller it can provide a predictable offset. It is particularly useful for DDI interchanges. For diamonds, displacement may be useful if one exit ramp left is much heavier. The offset can be varied by traffic conditions or time of day. It is similar to a timed overlap.
Signal Optimization

• When using signal optimization software on a corridor where a diamond interchange is the focus, do you?:
  – First optimize the diamond alone
  – Then optimize the entire corridor
  – Reconcile the results, if different
    • Use cycle length constraints

• At diamonds with no left turn lanes and tight ramp spacing, shorter cycle lengths are likely to be best
Ideal Diamond Interchange Phasing

Exit ramp greens equal to travel time to far ramp

Inbound greens long enough to clear waiting vehicles

Outbound greens long enough to clear bridge
Phasing with One Heavy Exit Ramp

Optional right turn phase
# Phase Order and Travel Time

Results are from I-494 at Co Rd 9 simulation

<table>
<thead>
<tr>
<th>Phase Order</th>
<th>Peak</th>
<th>Travel Times</th>
<th>Thru Travel Times</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total Hrs.</td>
<td>Per veh</td>
</tr>
<tr>
<td>Lead - Lead</td>
<td>AM</td>
<td>69.0</td>
<td>72.1</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>82.9</td>
<td>76.3</td>
</tr>
<tr>
<td>WB Lag – EB Lead</td>
<td>AM</td>
<td>67.0</td>
<td>69.9</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>78.4</td>
<td>72.2</td>
</tr>
<tr>
<td>WB Lead – EB Lag</td>
<td>AM</td>
<td>70.1</td>
<td>73.2</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>81.0</td>
<td>74.7</td>
</tr>
<tr>
<td>Lag - Lag</td>
<td>AM</td>
<td>63.4</td>
<td>66.3</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>75.3</td>
<td>69.3</td>
</tr>
</tbody>
</table>
## Through Vehicles in Left Lane

Results are from I-494 at Co Rd 9 simulation

<table>
<thead>
<tr>
<th>Phase Order</th>
<th>Peak</th>
<th>Thrus in left lane</th>
<th>Left turn multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>WB</td>
<td>EB</td>
</tr>
<tr>
<td>Lead - Lead</td>
<td>AM</td>
<td>60</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>83</td>
<td>118</td>
</tr>
<tr>
<td>WB Lag – EB Lead</td>
<td>AM</td>
<td>79</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>60</td>
<td>26</td>
</tr>
<tr>
<td>WB Lead – EB Lag</td>
<td>AM</td>
<td>82</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>122</td>
<td>212</td>
</tr>
<tr>
<td>Lag - Lag</td>
<td>AM</td>
<td>136</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>148</td>
<td>232</td>
</tr>
</tbody>
</table>
Conclusions and Recommendations

• Have a long range view of the needs and your options

• Understand existing and forecast traffic
  – Understand the variables in the forecasts
    • Possible changes to the roadway network
    • Future development – how tenuous?

• Use planning level volume / capacity calculations for alternatives comparison
  – I don’t want to hear “We can make this work with the 2040 numbers if we can keep the NB LT phase at 15 seconds”.

• Develop a range of alternatives
  – From fine tuning geometrics
  – To alternative designs
Conclusions and Recommendations (Continued)

• How does the preferred alternative meet the project goals
  – Is the project “interim”?
    • A phase on the way to the “ultimate”
    • A temporary fix with its own life-cycle
  – Or will it be the answer for 20 or 30 years?

• Don’t build the wrong thing to standards

• Consider maintenance issues
  – But don’t let the tail wag the dog

• Consider signing requirements
  – Don’t build it if you can’t sign it
Other Phasing Examples
Texas 3 Phase

Name is based on pre-timed

Pretimed Control

Phase 1

Phase 2

Phase 3

Actuated Control

3,7

4,7

3,8

1,5

2,5

1,6

2,6

NEMA phase numbers have been added
Texas Three Phase

Dual ring controller:
1-2 3-4
5-6 7-8

Left turns are both lead and lag
Texas 4 Phase

NEMA phase numbers have been added

Name is based on pre-timed
Texas Four Phase

Dual ring controller:
1-2 3-4
5-6 7-8

This is a modified single entry pattern
If Frontage Road Throughs are High

Dual ring controller:
1-2  3-4
5-6  7-8

This pattern used in Duluth at 5th West
Questions?

And.....be wary of unnecessary precision

Dennis Eyler – deyler@srfconsulting.com
Acknowledgements

• Photos are from Google Earth unless noted otherwise

• Locations of photos:
  - Slide 9 - Maryland 100 at Maryland 103
  - Slide 9– I-15 at Utah 130, Cedar City, Utah
  - Slide 9 – US 101 at Linderoc Cyn. Rd, Westlake Village, Los Angeles, CA
  - Slide 9 – I-43 at WI 241, Milwaukee, WI
  - Slide 10 – Minn 101 at 141st, I-494 at 34th
  - Slide 14 – MN 36 at MN 49, Roseville, MN and I-5 at Euclid, Anaheim, CA
  - Slide 15 – I-81 at Halfway Rd., Hagerstown, MD
  - Slide 16 and 17– I-94 at Co Rd 30, Maple Grove, MN
  - Slide 21– I-494 at 34th Av., Bloomington, MN
  - Slide 25– I-35 at Co Rd 50, Lakeville, MN
  - Slide 30 – I-494 at US 169, Bloomington, MN
  - Slide 31 – I-494 at Co Rd 9, Plymouth, MN
  - Slide 35 – I-80 at Alt US 89 – Fernley, NV
  - Slide 40 - Maryland 100 at Snowden River Parkway, Ellicott City, MD
  - Slide 41 – I-494 at Co Rd 9 in Plymouth, MN
  - Slide 42 – TH 55 east of I-494 in Plymouth
  - Slide 43 – I-35 at IA 160 in Ankeny, IA
  - Slide 44 – I-94 at Woodbury Drive, Woodbury, MN
  - Slide 45 – US 169 at Bren Rd, Minnetonka, MN
  - Slide 46 - US 212 at Mitchell Rd, Eden Prairie, MN
  - Slide 47– Minn 55 at I-494
  - Slide 48 – I-494 at 12th Avenue
  - Slide 69 - ??
Metro Diamonds with 4 or Fewer Lanes

• TH 5 at Post Road - 2
• TH 10/61 at Jamaica-3+R/A
• TH 10/61 at Innovation - 2
• TH 10 at TH 47 N. Jct.-4
• TH 12 at TH 101 No. Jct.-4
• I-35E at TH 13 – 4
• I-35E at Randolph - 4
• I-35E at Victoria - 2
• I-35E at St. Clair - 2
• I-35E at Grand – 4 - unb
• I-35E at Wheelock-2
• I-35E at Rose Lawn-2
• I-35W at 94th-4
• I-35W at 90th-4
• I-35W at 8nd-4
• I-35W at Diamond Lake-4
• I-35W at 46th-4
• I-35W at 31st
• I-35W at Co Rd D
• I-35W at Co Rd E-2
• I-35 at TH 97 - 2
• I-35 at CSAH 22 – 3+shlds
• I-35 at CSAH 19 - 2
• I-35 at CSAH 17 - 3
• TH 36 at Hamline – 2 +shlds
• TH 36 at Lexington - 3
• TH 36 at Edgerton – 3 +shld

Red lettering = signals
Unb = unbalanced lanes
R/A = roundabouts
### Metro Diamonds with 4 or Fewer Lanes

- TH 36 at English – 4 +shlds
- TH 36 at Hilton Trail – 2 R/A
- TH 51 at Pierce Butler – 2
- TH 51 at Energy park – 4
- TH 52 at Mendota – 3 +shld
- TH 52 at Wentworth – 2 R/A
- TH 52 at Thompson – 3 +shlds
- TH 52 at Butler – 2 +shlds
- TH 55 at TH 3 – 3 +shlds
- TH 62 at Tracy – 4
- TH 62 at Gleason – 3
- TH 62 at Valley View – 4 - unb
- TH 62 at Xerxes – 4
- TH 62 at Penn – 4
- TH 62 at Portland – 4
- TH 62 at 28th – 2 +shlds
- TH 62 at 34th – 2 +shlds
- TH 77 at 127th – 3 +shlds
- I-94 at Co Rd 37 – 2 +shlds
- I-94 at TH 241 – 3 +shlds
- I-94 at 53rd – 2 +shlds
- I-94 at 49th – 3 +shlds – all way
- I-94 at Dowling – 3 +shlds
- I-94 at Cedar – 4
- I-94 at 25th – 4
- I-94 at Riverside – 3 +shlds

- **Red lettering = signals**
- **Unb = unbalanced lanes**
- **R/A = roundabouts**
Metro Diamonds with 4 or Fewer Lanes

- I-94 at Hamline - 4
- I-94 at White Bear - 4
- I-94 at Ruth – 3 +shlds
- TH 100 at Benton – 3 +shlds
- TH 100 at Eden - 2
- TH 169 at Valley View – 4 unb
- TH 169 at 7th – 2 +shlds
- TH 169 at 36th St. – 2 +shlds
- TH 169 at Minnetonka – 3 +shld
- TH 169 at Cedar Lake Rd – 4 unb
- TH 169 at Betty Crocker - 4
- TH 169 at 13th - 4
- TH 169 at Medicine Lk – 3 + shlds
- TH 169 at 36th Ave No. - 4
- TH 169 at 49th - 4
- TH 169 at 63rd - 2
- TH 169 at 77th - 4
- I-494 at CSAH 9 - 4
- I-494 at Nicollet - 4
- I-494 at Portland - 4
- I-494 at 12th – 3 unb
- I-494 at Hardman - 3
- I-494 at Maxwell - 4 unb

Red lettering = signals
Unb = unbalanced lanes
R/A = roundabouts
Existing Freeway Crossings Without Interchanges