

Developing a Turn Lane Policy

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Joe Gustafson – Traffic Engineer



Project Origin

- No written Washington County turn lane policy.
- Mitigation occurs via permit process (Comp Plan and ROW ordinance)
 - Turn lanes paid for by applicant
 - Only chance for developer to offset their impact
- Practice: 10 residential units (100 trips per day) = RTL + Bypass
- Bypass lanes out of favor → What's our LTL threshold?
- Increasing risk of pushback?

Pros and Cons of Turn Lanes

- Turn lanes have some drawbacks
 - Longer pedestrian crossings, multiple-threat issues
 - More pavement (impervious, maintenance, etc)
 - Number of lanes vs. whose turn to go?
- Benefits can vary widely depending on context
 - Mainline vs. sidestreet
 - High speed vs. low speed
 - Uncontrolled vs. stop sign vs. signal control

Mainline Turn Lane Benefits

- Promote **mobility** and uniform speeds
- Promote **safety** by reducing rear-end crash risk
- Promote **safety** by reducing passing maneuvers
 - Passing on left (OK to pass a right-turner, but not a left-turner)
 - Passing on shoulder (illegal)
 - Passing in a turn lane (illegal)
- Promote **yielding** to parallel pedestrians/trail users
- No benefit when thru vehicles don't encounter turning vehicles (low volume)

Sidestreet Turn Lane Benefits

- Sidestreet Right turn lanes:
 - Allow right turns to safely slip past thru/left vehicles
 - NOT beneficial when volumes are low.
- Sidestreet Left turn lanes:
 - Not beneficial at unsignalized sidestreets, unless needed for capacity
 - At traffic signals:
 - Allow for sidestreet left turn phase (green arrow)
 - Prevent unsafe passing on the right during sidestreet green

Other Counties

- Informal email survey of other metro counties
 - 10 residential units is a common threshold for RTL's
 - Surprising lack of written polices, especially for LTL's

MnDOT Access Management Manual

- **Undivided roads**

- 8 different warrants (Railroad, schools, signals, freight, sight distance, etc).
- LTL's based on a chart. Exempt below 1500 major ADT.
- RTL's required at 45+ mph and 1500 ADT per lane. Exempt below 100 minor ADT.

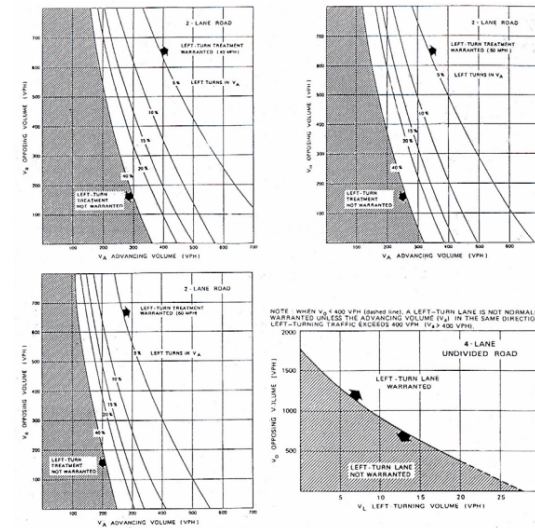
- **Divided roads**

- Left Turn Lanes:
 - At all public street connections
 - At any driveways with median openings
- Right Turn Lanes:
 - At all public streets
 - All driveways serving 5+ units
 - All driveways over 50 ADT.

Other Guidelines

- AASHTO Green Book
 - Based on Harmelink, 1967
 - Only for LTL's on 2-lane highways.
 - No guidance for 4-lanes, or RTL's, or under 40 mph.
- NCHRP 279
 - Provided graphs as per Harmelink, 1967.

Opposing volume (veh/h)	Advancing volume (veh/h)			
	5% left turns	10% left turns	20% left turns	30% left turns
40-mph operating speed				
800	330	240	180	160
600	410	305	225	200
400	510	380	275	245
200	640	470	350	305
100	720	515	390	340
50-mph operating speed				
800	280	210	165	135
600	350	260	195	170
400	430	320	240	210
200	550	400	300	270
100	615	445	335	295
60-mph operating speed				
800	230	170	125	115
600	290	210	160	140
400	365	270	200	175
200	450	330	250	215
100	505	370	275	240



Other Considerations

- So far, this is all about when you should build a turn lane.
- **But**, what about how long the turn lane should be?
 - LRRB – Design of Turn Lane Guidelines <https://www.lrrb.org/pdf/201025.pdf>
 - Allow some deceleration in thru lane? (None vs. 10 mph of deceleration)
 - Sidestreet Turn Lanes:
 - If stop-controlled or low-speed, then long enough to slip past typical max queues.
 - If signalized, then same length as if it was a mainline, especially at higher speeds

Project Goals

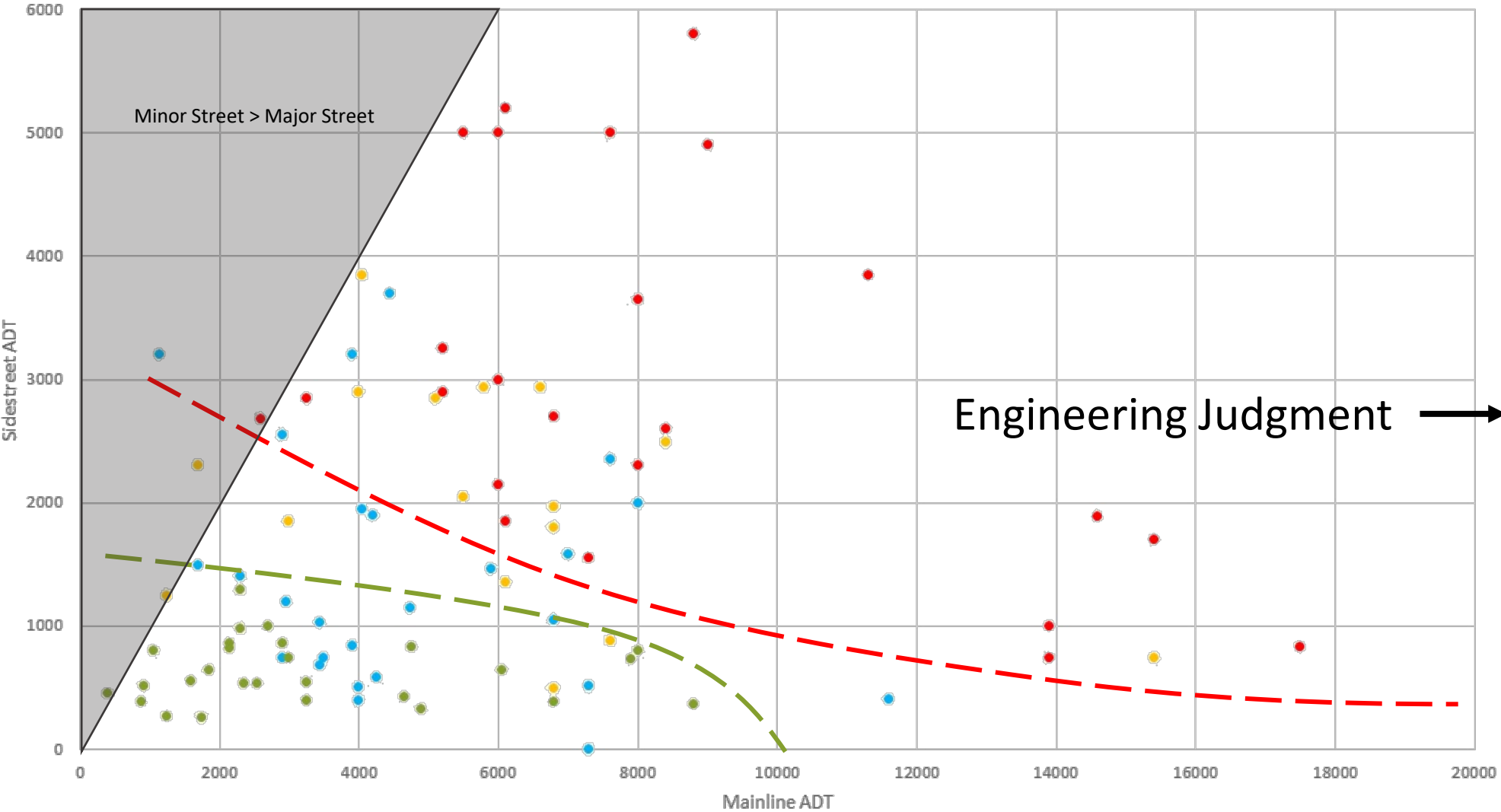
- Adopt a written policy
- Take into account range of speeds, volumes, approach, control type
- Don't get too deep in the weeds
- Appropriately consider future traffic growth
- Provide a policy framework for:
 - When are right turn lanes required?
 - When are left turn lanes required?
 - How long should turn lanes be?



First Step – RTL Hypotheticals

- 99 real-world Washington County intersections
- Limited to where we knew the cross street ADT
- Variety of speeds
- Engineering judgment of Right Turn Lane needs

Location	Mainline ADT	Cross Street ADT	Recommendation
10th at 21	2600	2684	Yes
11 at 7	1600	550	No
11 at 96	3912	840	Probably not
12 at 5	8800	5800	Yes
125th at 7	1850	640	No
14E at 21	3000	1850	Probably
15th at 13	8400	2495	Probably
17 at 12	7600	5000	Yes
20th at 17	3450	683	Probably not
22 at 21	1250	1250	Probably
3 at 7	2300	980	No
30th at 17	3450	1032	Probably not
30th at 21	3500	740	Probably not
30th at 65	2900	740	Probably not
30thE at 15	13900	740	Yes
30thW at 15	13900	995	yes
3N at 4	2900	2550	Probably not
3S at 4	2900	860	No

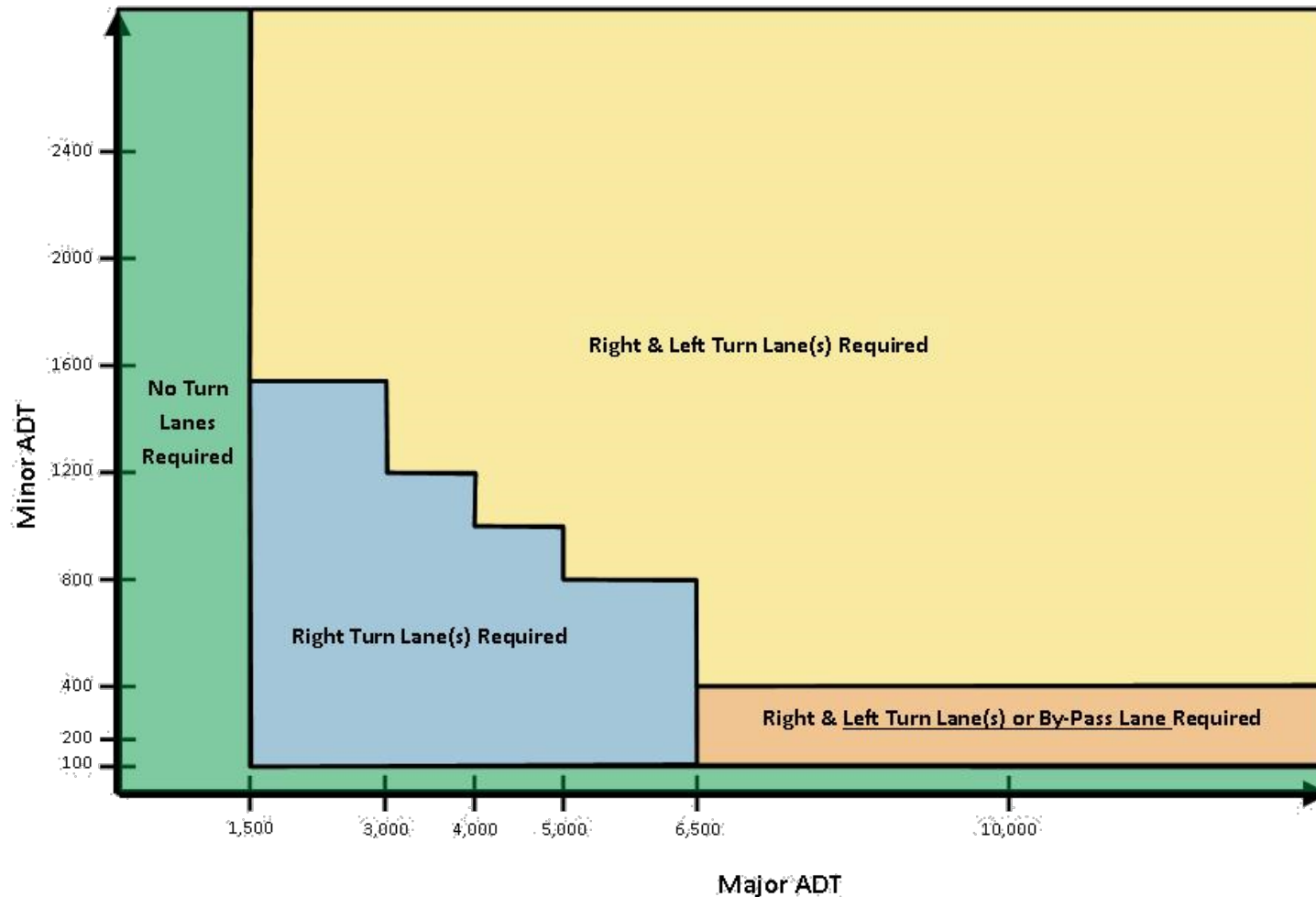


- Needs RTL
- Probably Needs RTL
- Probably Doesn't
- Nope

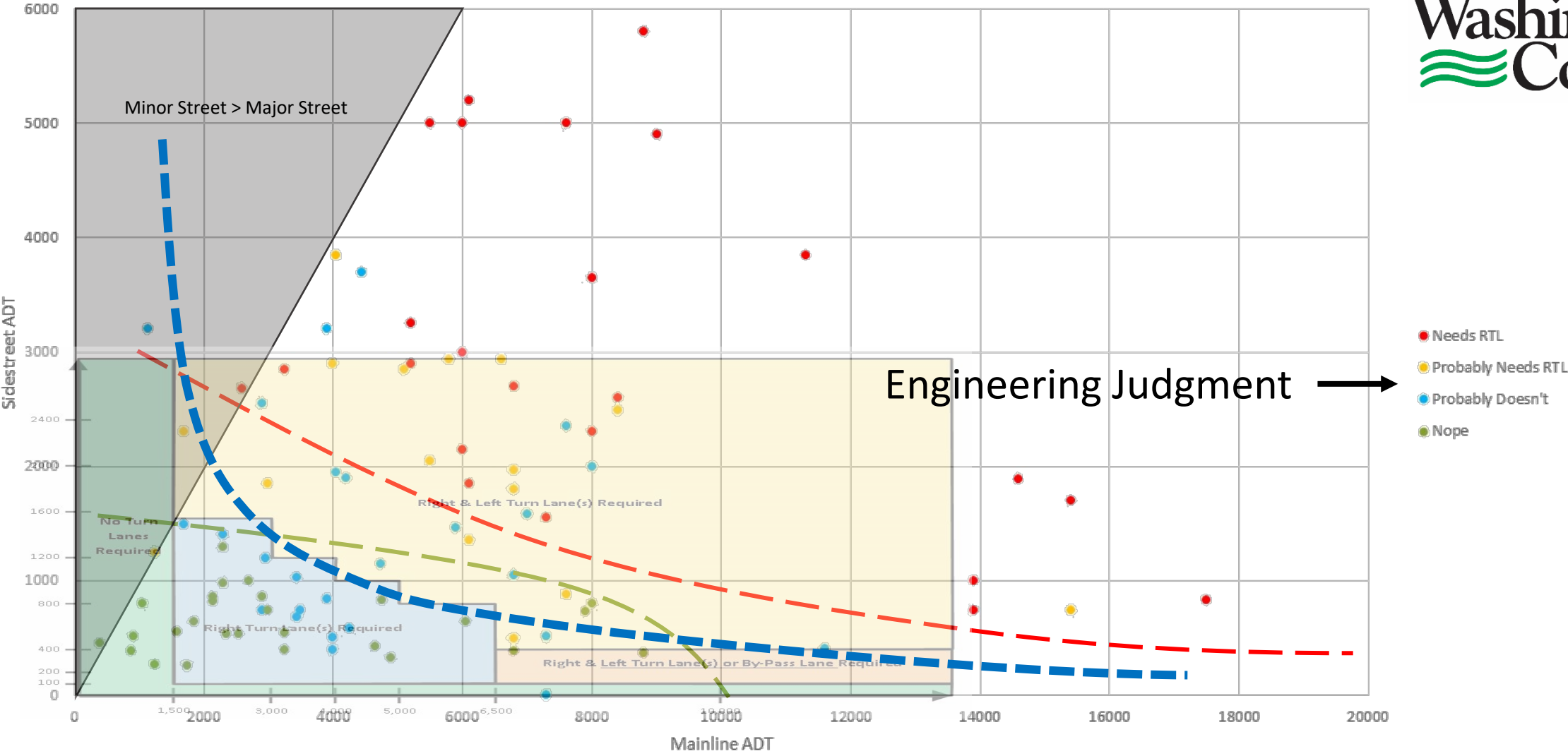
Engineering Judgment →

MnDOT Turn Lane Warrants for New or Modified Accesses

2-Lane High Speed (≥ 45 MPH) Highways

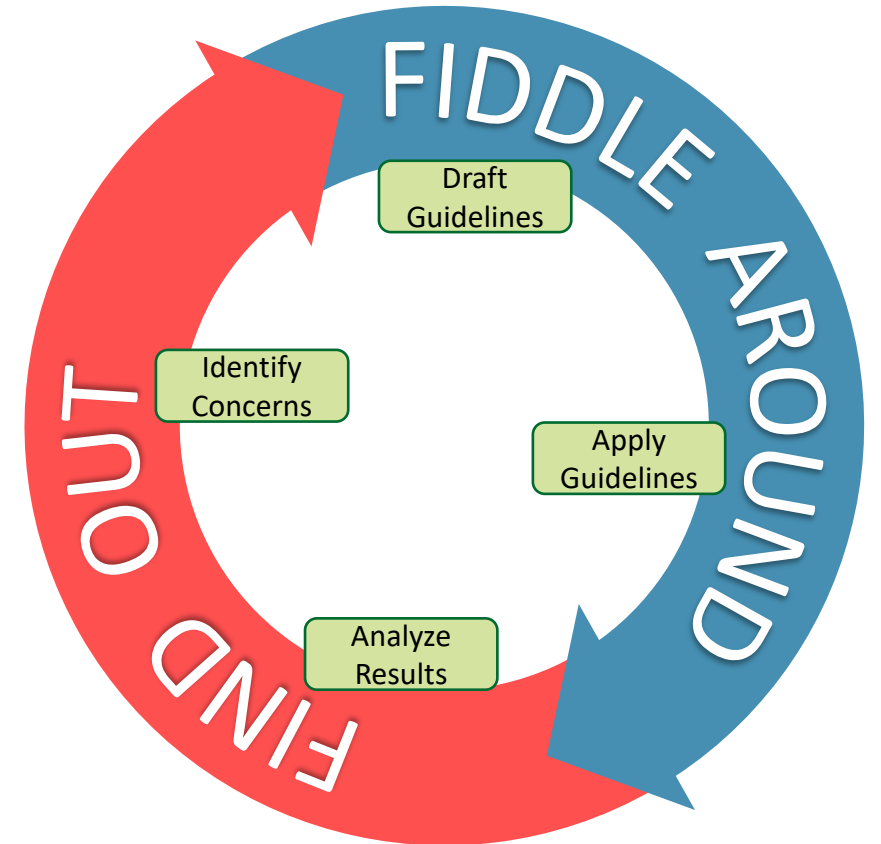


- No turn lanes under 1500 Major ADT
- No turn lanes under 100 Minor ADT



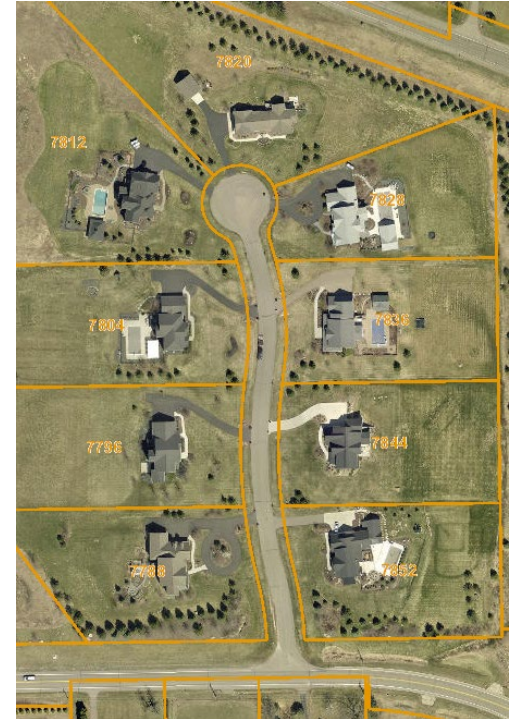
Next Step

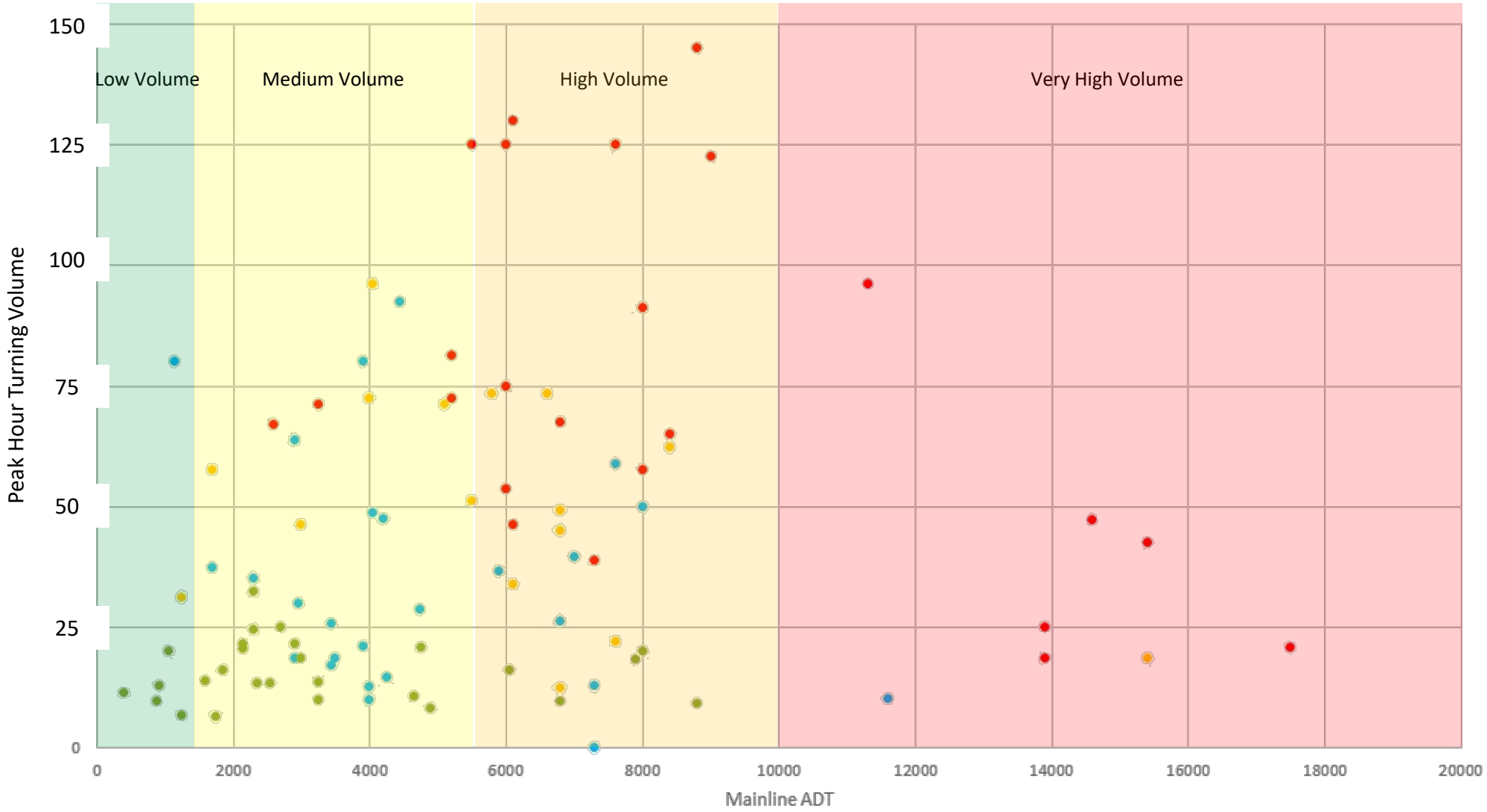
- Develop draft guidelines
- “Stress-Test” those draft guidelines
 - Real-world locations
 - Do we agree with the results?
 - If not, why not?
 - Adjust draft guidelines
 - Test again
- High speed vs. low speed?
- Daily volume vs. hourly volume? (e.g. schools)

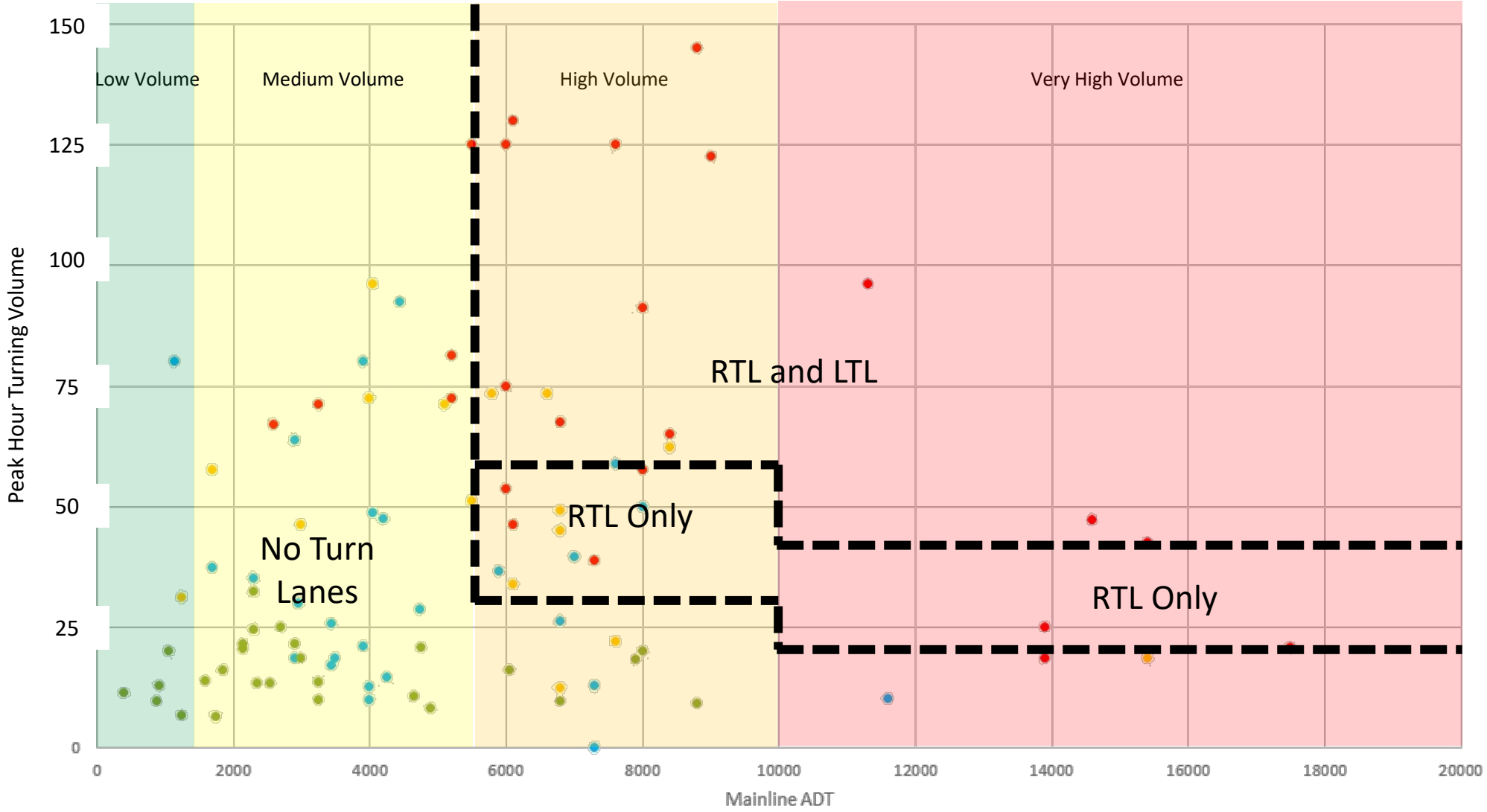


Daily vs. Hourly Volume

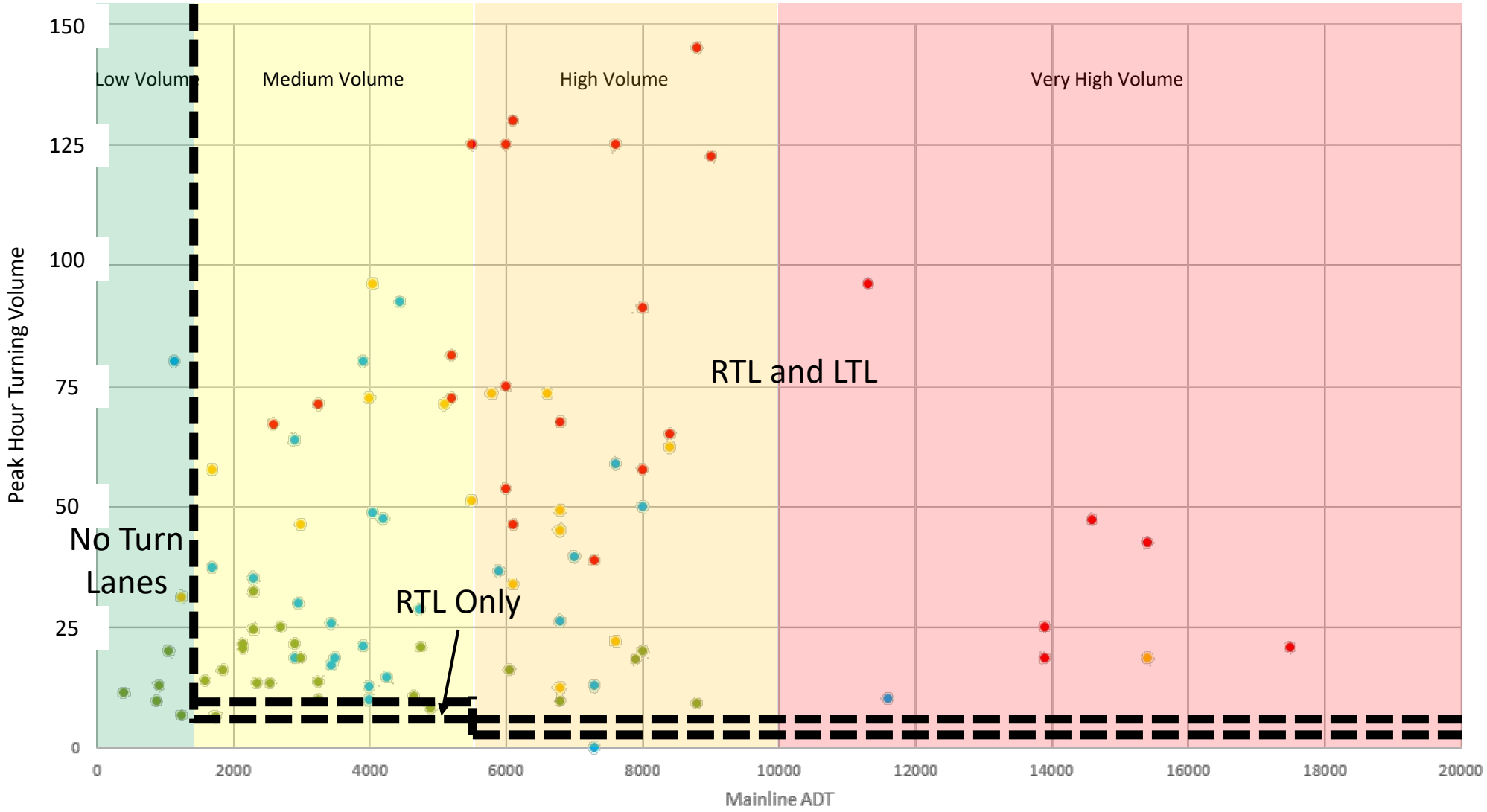
- Hourly made more sense for a basis
- Specifically, hourly use of the turn lane
- Consider a 10-lot residential cul-de-sac
- Using some rules of thumb:
 - Single family detached home = 10 trips per day (ITE)
 - So, 10-lot residential cul-de-sac = 100 ADT
 - 10% of ADT usually occurs during peak hour = 10 trips during peak hour
 - 50/50 inbound/outbound split = 5 inbound trips + 5 outbound trips
 - 50/50 directional split between = 2.5 inbound trips per direction
 - **Rough rule of thumb: Inbound trips per direction x 40 = Access ADT**







DRAFT
Mainline Turn Lanes
Lower Speed Roads
(40 MPH and Below)



DRAFT
Mainline Turn Lanes
Higher Speed Roads
(45 MPH and Above)

Proposed New Turn Lane Requirements

Mainline (County Highway) Turn Lanes

	Low Volume (< 1,500 ADT)	Medium Volume (< 5,500 ADT)	High Volume (5,500 - 9,999 ADT)	Very High Volume (≥ 10,000 ADT)
Low Speed (≤ 40 MPH)	Turn Lanes Not Required	Turn Lanes Not Required	RTL(s) Required at PHTV of 30 or More	RTL(s) Required at PHTV of 20 or More
			LTL(s) Required at PHTV of 60 or More	LTL(s) Required at PHTV of 40 or More
RTL(s) Required at PHTV of 5 or More		RTL(s) Required at PHTV of 3 or More		
LTL(s) Required at PHTV of 10 or More		LTL(s) Required at PHTV of 5 or More		
High Speed (≥ 45 MPH)				

Side Street Turn Lanes

Scenario (#)	Anticipated Side Street ADT (#)	Mainline ADT (#)	Sidestreet Lanes Required
1	< 500	Any	No Turn Lanes
2	500 to 1499	< 10,000 ADT	No Turn Lanes
3	500 to 1499	≥ 10,000 ADT	Right Turn Lane ⁽¹⁾
4	1500 to 2499	Any	RTL if Mainline Over 35 mph
5	≥ 2,500	Any	RTL ⁽¹⁾
6	All-Way Stop or Roundabout		Fewest lanes to maintain operations
7	Signalized Intersection		LTL, Thru, and RTL ⁽²⁾

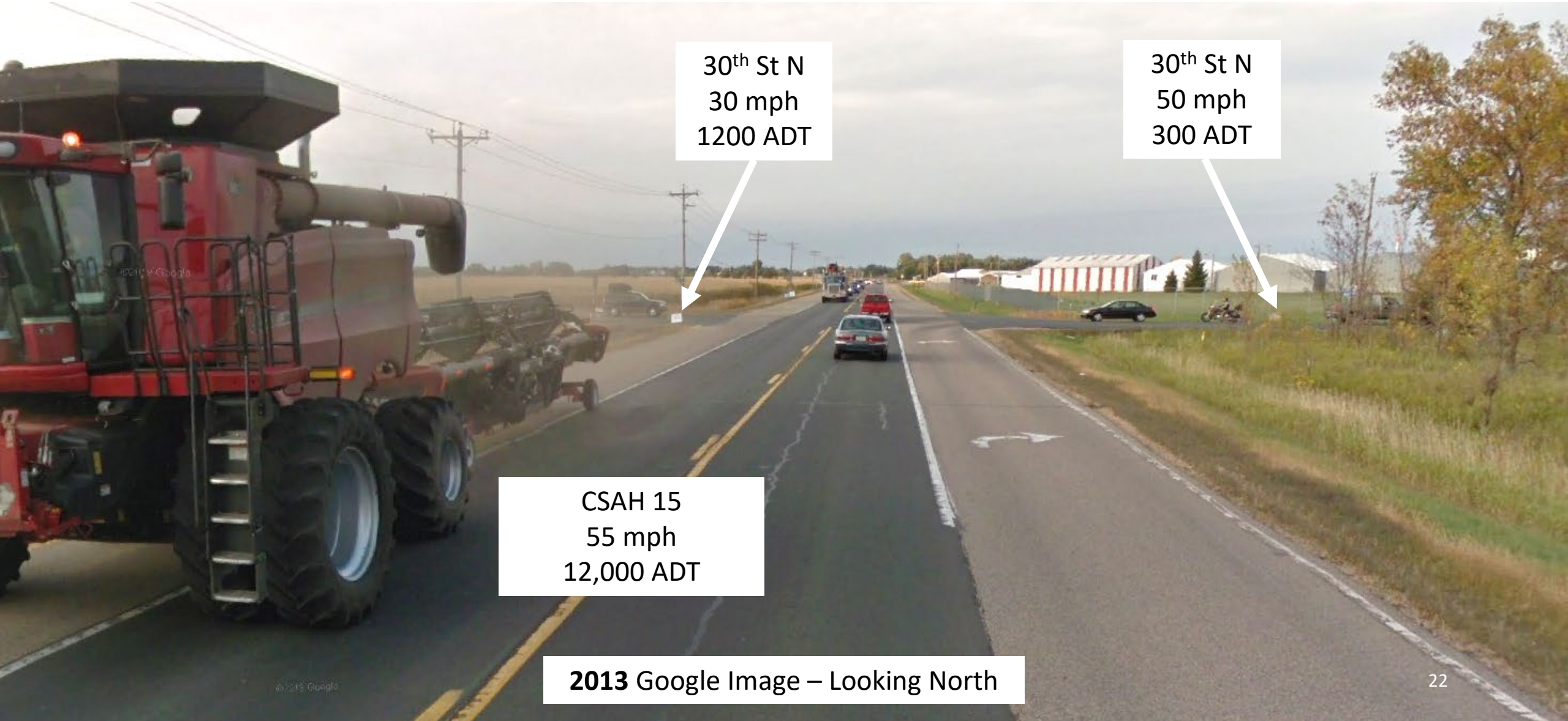
ADT = Average Daily Traffic
 MPH = Miles Per Hour
 RTL(s) = Right Turn Lane(s)
 LTL(s) = Left Turn Lane(s)
 PHTV = Peak Hour Turning Volume

(1) - Dedicated thru or turn lane may be omitted if Peak Hour movement volume is below 30 VPH.

(2) - May omit dedicated LTLs for sidestreets 40 mph or under. Use higher speed sidestreet; reduce by 5 mph if difference between sidestreet legs is greater than 10 mph.

“Unless needed for capacity”

Case Study #1 – CSAH 15 @ 30th St



30th St N
30 mph
1200 ADT

30th St N
50 mph
300 ADT

CSAH 15
55 mph
12,000 ADT

2013 Google Image – Looking North

Case Study #1 – CSAH 15 @ 30th St

30th St N
30 mph
1200 ADT

30th St N
50 mph
300 ADT

CSAH 15
55 mph
12,000 ADT

2021 Google Image – Looking North

Case Study #1 – CSAH 15 @ 30th St



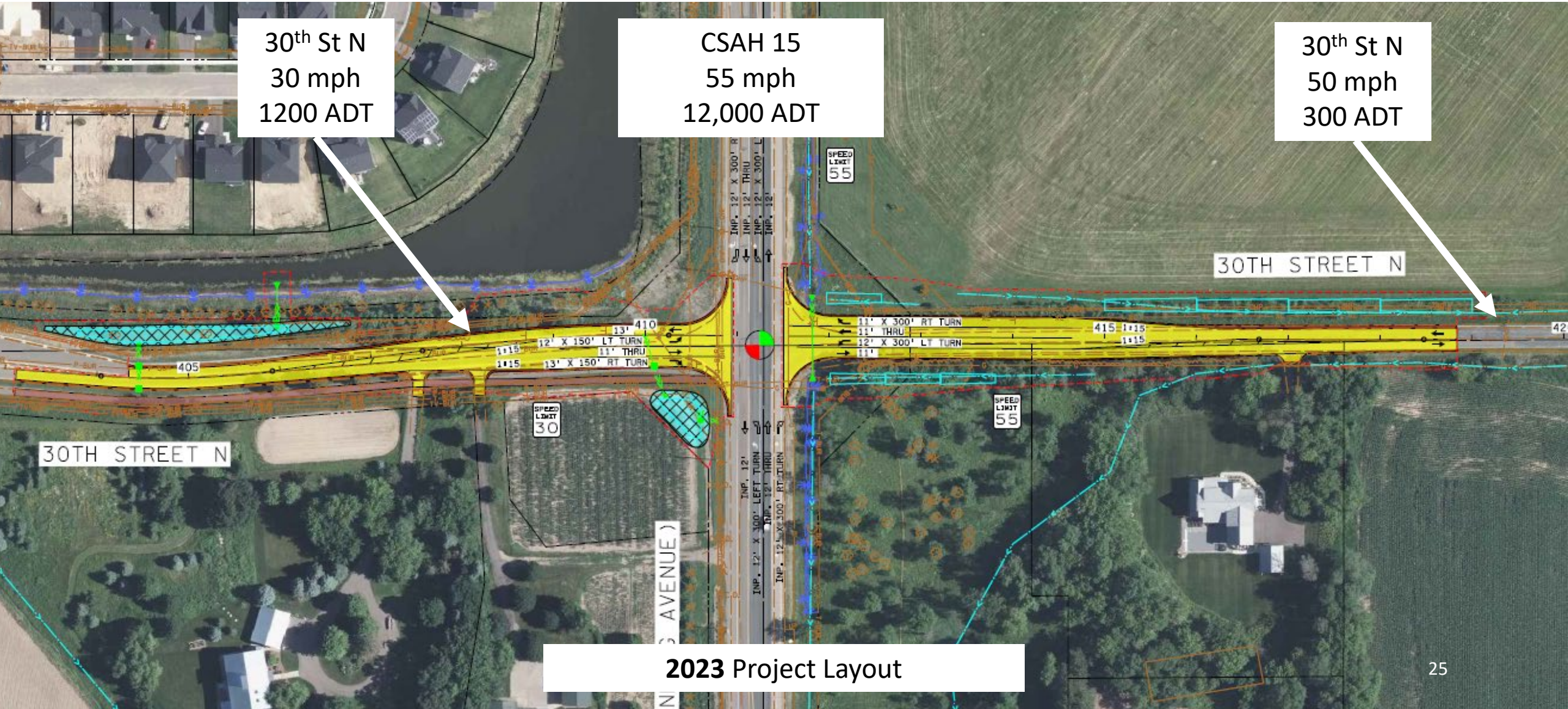
30th St N
30 mph
1200 ADT

30th St N
50 mph
300 ADT

CSAH 15
55 mph
12,000 ADT

2023 Google Image – Looking North

Case Study #1 – CSAH 15 @ 30th St



2023 Project Layout

Case Study #1 – CSAH 15 @ 30th St

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High Speed (≥ 45 MPH)			RTL(s) Required at PHTV of 5 or More	RTL(s) Required at PHTV of 3 or More
		LTL(s) Required at PHTV of 10 or More	LTL(s) Required at PHTV of 5 or More	
			LTL(s) Required at PHTV of 60 or More	LTL(s) Required at PHTV of 40 or More

Side Street Turn Lanes

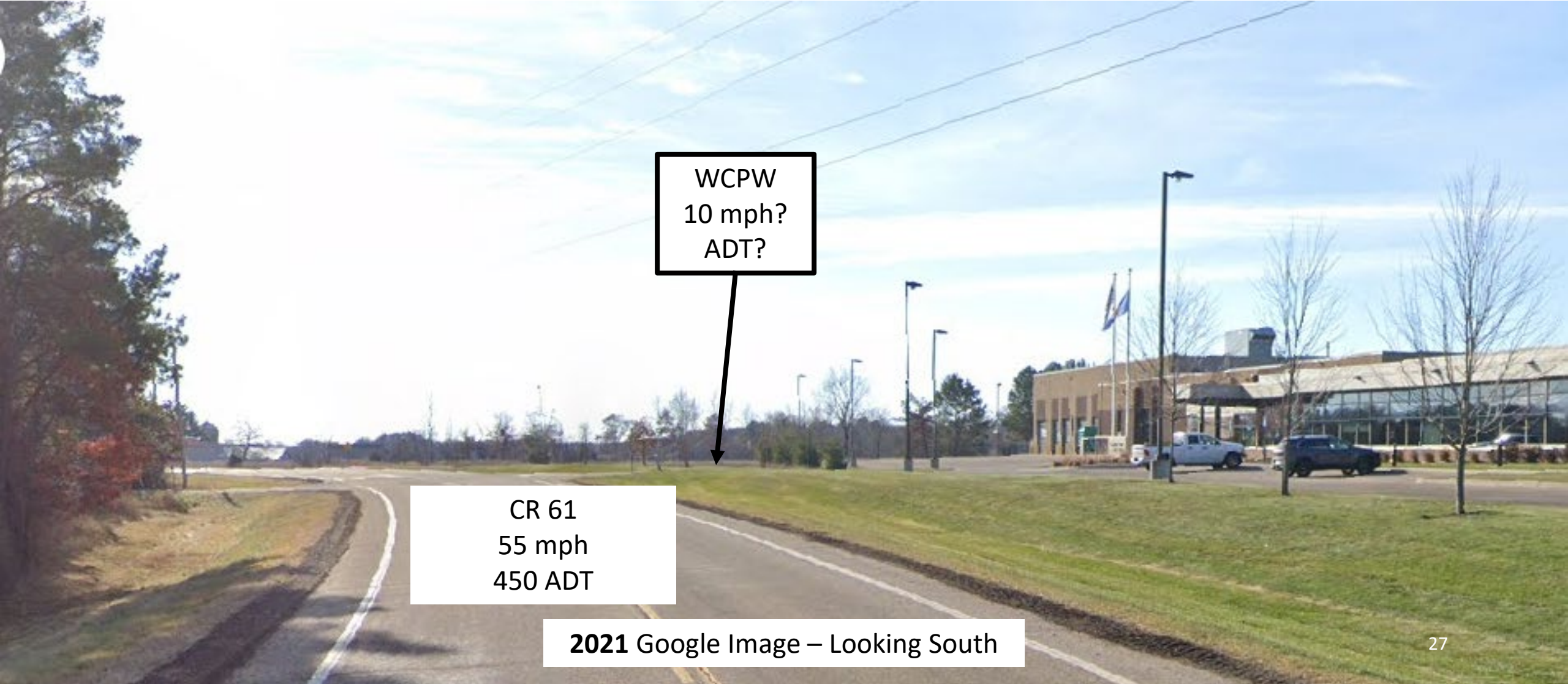
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4	1500 to 2499	Any	RTL if Mainline Over 35 mph
5	≥ 2,500	Any	RTL ⁽¹⁾
6	All-Way Stop or Roundabout		Fewest lanes to maintain operations
7	Signalized Intersection		LTL, Thru, and RTL ⁽²⁾

(1) - Dedicated thru or turn lane may be omitted if Peak Hour movement volume is below 30 VPH. (30 is a shot in the dark - Could increase it)

(2) - May omit dedicated LTLs for sidestreets 40 mph or under. Use higher speed sidestreet; reduce by 5 mph if difference between sidestreet legs is greater than 10 mph.

Result: RTL and LTL on all four legs. Does **not** qualify for Note 2 exemption.

Case Study #2 – CR 61 @ WCPW



WCPW
10 mph?
ADT?

CR 61
55 mph
450 ADT

2021 Google Image – Looking South

Case Study #2 – CR 61 @ WCPW

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Side Street Turn Lanes

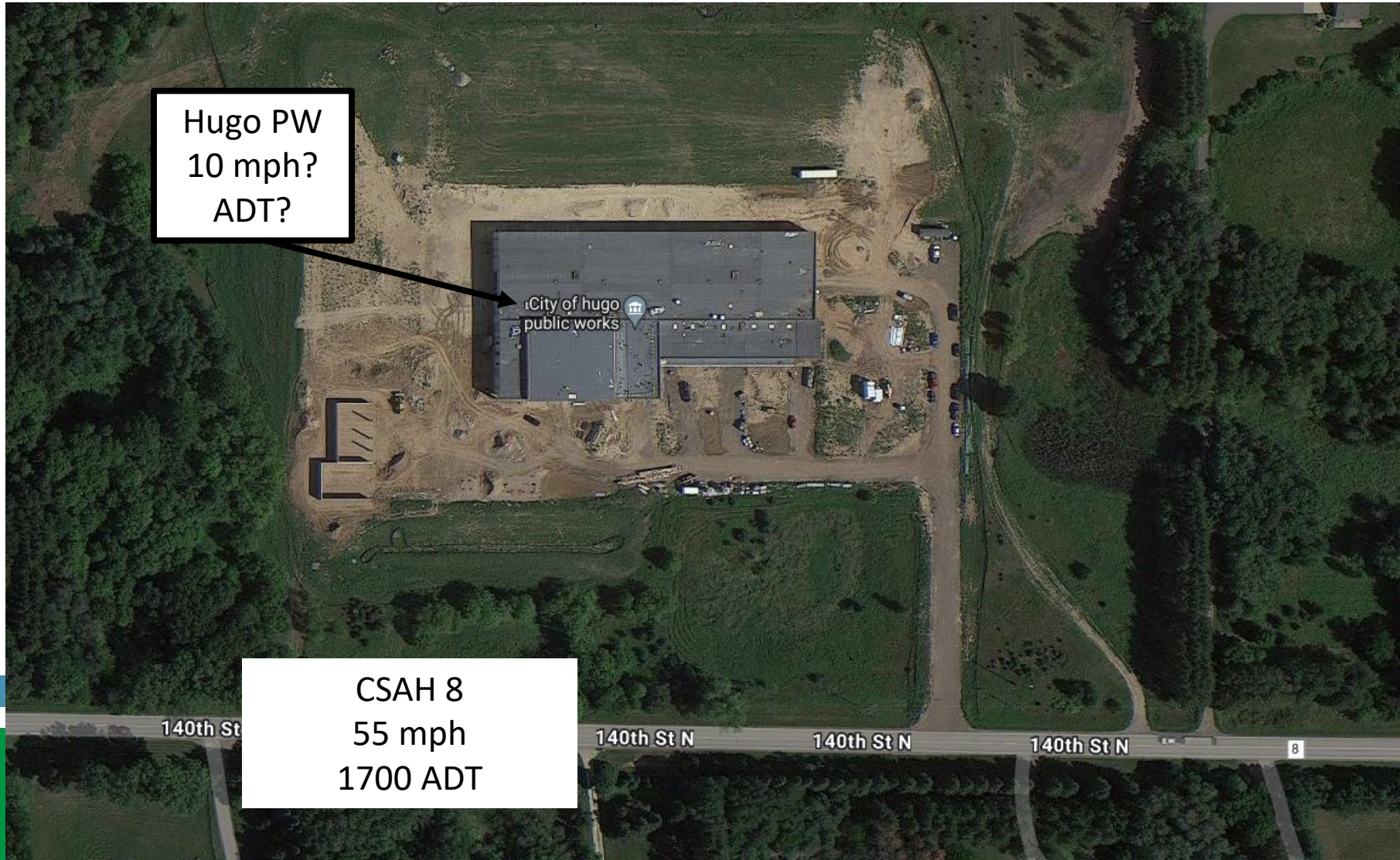
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(2) - May omit dedicated LTLs for sidestreets 40 mph or under. Use higher speed sidestreet; reduce by 5 mph if difference between sidestreet legs is greater than 10 mph.

Result: No turn lanes are required.

Case Study #3 – CSAH 8 / Hugo PW



Hugo PW
10 mph?
ADT?

CSAH 8
55 mph
1700 ADT

Case Study #3 – CSAH 8 / Hugo PW

Mainline (County Highway) Turn Lanes

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		RTL(s) Required at PHTV of 5 or More	RTL(s) Required at PHTV of 3 or More	
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Result: Turn lanes potentially required depending on volume.

Case Study #4 – CSAH 33 Apts



Apartments
10 mph?
1000 ADT?

CSAH 33
40 mph
4600 ADT

2023 Google Image – Looking South

Case Study #4 – CSAH 33 Apts

Mainline (County Highway) Turn Lanes

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		LTL(s) Required at PHTV of 10 or More	LTL(s) Required at PHTV of 5 or More	

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Result: No turn lanes required.

Turn lane length

- Mainline Turn Lanes: Use LRRB document based on speed and deceleration
- Sidestreet Turn Lanes:
 - Stop Control: Long enough to accommodate typical max queues (95%?)
 - Signalized & Low Speed
 - Long enough to accommodate max queues, OR
 - Use LRRB document (whichever is longer)
 - Signalized & High Speed: Use LRRB document

Acknowledgements

- Mitch Bartelt, PE
- Andrew Giesen, PE
- Wayne Sandberg, PE

References

- MnDOT Access Management Manual:
 - <http://www.dot.state.mn.us/accessmanagement/pdf/manualchapters/chapter3.pdf>
- LRRB – Design of Turn lane guidelines (length)
 - <https://www.lrrb.org/pdf/201025.pdf>
- Northeast ITE Turn Lane Warrants Review (2004)
 - http://www.neite.org/vt/dist1_2004/Safety%20Design%20Considerations/David%20DeBaie%20Paper.pdf
- AASHTO Green Book