

To: Mayor and City Council

From: Damion Pregitzer, P.E. PTOE, Traffic Engineering Manager

Date: November 25, 2024

Subject: Recommended Intersection Alternative for 13th Street and Grand Avenue

BACKGROUND:

The City Council requested that staff evaluate multiple improvement options for the 13th Street and Grand Avenue intersection, specifically an option that would split all four directions of the signal to run separately (Alternative B) and an option to three-lane each approach (Alternative C). Since then, staff, in collaboration with HDR, has completed a comprehensive study of those alternatives, including a do nothing alternative (No-Build). The attached report provides an overview of each alternative, analyzing performance measures such as emissions, queuing, and pedestrian impacts.

The study concludes that Alternative A: Widen Intersection with Left-Turn Lanes in All Directions offers the best overall performance across these metrics. This is the design concept identified in the Grand Avenue Corridor Study completed on October 25, 2022. Key considerations supporting Alternative A include:

1. **Environmental Impact:** Alternative A achieves the greatest reduction in greenhouse gas (GHG) emissions, with an anticipated 33.6% decrease compared to no-build conditions and 45.6%/37.2% reductions compared to Alternative B/C respectively. This option aligns with the City's environmental objectives and mitigates emissions impacts and lower Green House Gases (GHGs).
2. **Traffic Management:** Alternative A offers the most manageable (shortest) queuing, essential for optimizing the effectiveness of the City's Intelligent Transportation Systems (ITS) and adaptive traffic control program. This alternative helps maximize what will be, at the time of its completion, over \$7,000,000 investment in these technologies. It should be noted that these technologies have substantial funding from Iowa DOT Iowa Clean Air Attainment Program (ICAAP) grants and are expected to have a high return on investment for GHG reductions.

3. **Pedestrian Operations:** While Alternative A results in a longer crossing distance (78 feet), it provides the shortest average pedestrian wait time at 85 seconds—significantly less than the potential maximum wait of 135 seconds for Alternative B and 121 seconds for the No-Build (current) situation. It also has essentially the same (one second less) wait time than the road diet (Alternative C).

Longer wait times can lead to frustration and may cause risky decisions by pedestrians and cyclists, increasing the likelihood of crossing against signals or other unsafe actions. Staff is confident that Alternative A can provide the most supportive option for efficient pedestrian flow while balancing other multimodal priorities.

4. **CyRide Compatibility:** With dedicated left-turn lanes, Alternative A minimizes delays and conflicts with CyRide operations, allowing transit services to maintain better scheduling and reducing interactions between buses and other vehicle traffic. Additionally, by supporting the adaptive traffic system in this corridor, Alternative A improves overall traffic flow, which is expected to enhance the reliability of transit headways.
5. **Neighborhood Impact and Network Hierarchy:** Alternative A most effectively promotes use of the arterial street network, discouraging cut-through traffic on nearby residential streets. By minimizing congestion and queuing, Alternative A helps reduce traffic diversion into neighborhoods. This allows the City to prioritize pedestrian and cyclist uses on the nearby collector and local street systems, aligning with the goals of our Bike and Pedestrian Plan.

NEXT STEPS:

Alternative A best meets the City's long-term goals for sustainability, efficient traffic management, pedestrian safety, and CyRide coordination, making it the optimal solution for reducing environmental impact and supporting multimodal transportation not only at this location but city-wide.

Therefore, Staff will continue proceeding with development of *Alternative A: Widen Intersection with Left-Turn Lanes in All Directions* for the 13th Street and Grand Avenue improvements, unless otherwise directed by City Council.

Attachment (1): HDR Analysis

Memo

Date: Tuesday, November 05, 2024

Project: 13th Street & Grand Avenue Traffic Analysis

To: City of Ames

From: HDR

Subject: Analysis Summary

Executive Summary

Traffic conditions at 13th Street & Grand Avenue were evaluated for the alternatives listed below to assess feasibility of each to accommodate expected future growth in the area:

- **Alternative A – Widen intersection:** Add left-turn lanes in all directions with protected/permitted left-turn phasing
- **Alternative B – No-build with modified phasing (4-Way Split-Phase with Protected Lefts):** Maintain north/south split phasing; modify east/west to split phasing
- **Alternative C – Road diet:** Modify north/south and east/west roadways to one through lane in each direction with dedicated left-turn lanes

The evaluations included quantitative operational performance and qualitative reviews for additional considerations. A summary of the completed evaluations, including operations during the worst-case peak hour (PM peak hour) is provided in **Table 1**.

Table 1: 13th Street & Grand Avenue Intersection Performance Summary

Scenario	Pedestrian Influence		CyRide Impact	Year 2045 PM Peak Hour Operations			
	Intersection Crossing Distance ¹	Maximum Wait Time to Cross ²		Average Vehicle Delay (s)	Level of Service (LOS)	Queue Length (longest queue approach, ft)	Total Emissions (g/hr)
Year 2045 No-Build	66 ft	121 sec	Low-Medium	53.0	D	561	6,833
Year 2045 Alternative A: Widen Intersection	78 ft	85 sec	Low	19.0	B	284	4,536
Year 2045 Alternative B: No-Build with Split Phase	66 ft	135 sec	Medium	79.5	E	696 ³	8,332
Year 2045 Alternative C: Road Diet	54 ft	86 sec	High	62.2	E	939 ³	7,226

Source: Delay, queue and emissions information from Synchro 12 software. Queue length is reported at the 95th percentile demand during the peak hour.

Colored cells indicate best to worst for performance measure of the Alternatives – Green (best), Yellow, Orange, Red (worst).

¹ Used average crossing distance at existing intersection for No-Build and Alternative B conditions. Added or subtracted 12 feet for Alternative A and Alternative C conditions.

² Maximum wait time estimated from optimized signal timings using the time between start of flash don't walk to start of walk in the subsequent signal cycle.

³ Queue length is for a movement over capacity at the 95th percentile flow and may be significantly longer.

Other considerations for alternatives reviewed with the study concluded:

- Traffic diversion from Grand Avenue to other routes would be expected for Alternatives B and C to avoid high delay at the 13th Street intersection. This may place additional traffic on lower classification roadways, such as neighborhood streets, that are designated for safe and efficient movement of pedestrians and bicyclists. A 30% diversion of Grand Avenue PM peak hour traffic (about 500 vehicles) would result in LOS C operations for Alternative C, when no diversion would be likely. Likely diversion routes include Duff Avenue, Clark Avenue and Northwestern Avenue. Diverted traffic onto neighborhood streets may be accompanied by speeding of drivers trying to make up time along their diverted route. Adding left-turn lanes via Alternative A may reduce trip diversion on adjacent neighborhood streets that is currently occurring or might occur in the future.
- The projected traffic volume for Grand Avenue is near the top of the threshold listed by FHWA for consideration of a road diet and may not be suitable for this corridor with direct driveway access and crossing roadways with moderate volume.

Introduction

This memo summarizes operations analysis completed for the intersection of 13th Street & Grand Avenue to evaluate operational feasibility of intersection configuration/improvement alternatives. Currently, 13th Street and Grand Avenue are both four-lane undivided roadways at the intersection with approach geometry of a shared through/left-turn lane and shared through/right-turn lane. The intersection is signalized with split phase operations for northbound and southbound traffic (one direction at a time) and permitted phasing for eastbound and westbound traffic (both directions operating concurrently).

The following alternatives were evaluated for the intersection:

- **Alternative A – Widen intersection:** Add left-turn lanes in all directions with protected/permitted left-turn phasing
- **Alternative B – No-build with modified phasing (4-Way Split-Phase with Protected Lefts):** Maintain north/south split phasing; modify east/west to split phasing
- **Alternative C – Road diet:** Modify north/south and east/west roadways to one through lane in each direction with dedicated left-turn lanes

Operations evaluations were completed for year 2045 AM and PM peak hour traffic forecasts using Synchro software. These evaluations build on previous analyses completed for the Grand Avenue Intersection Improvements Study completed in 2022, which documented Alternative A as the improvements for future implementation at the intersection.

Traffic Forecasts

Year 2045 peak hour traffic forecasts, obtained from the Grand Avenue Intersection Improvements Study, are shown in **Figure 1**. The PM peak hour volumes are about 35% greater than the AM peak hour volumes. A review of 2021 count data at the intersection shows that midday volumes are also higher than the AM peak hour volumes and PM peaking last about 1 ½ - 2 hours (**Figure 2**).

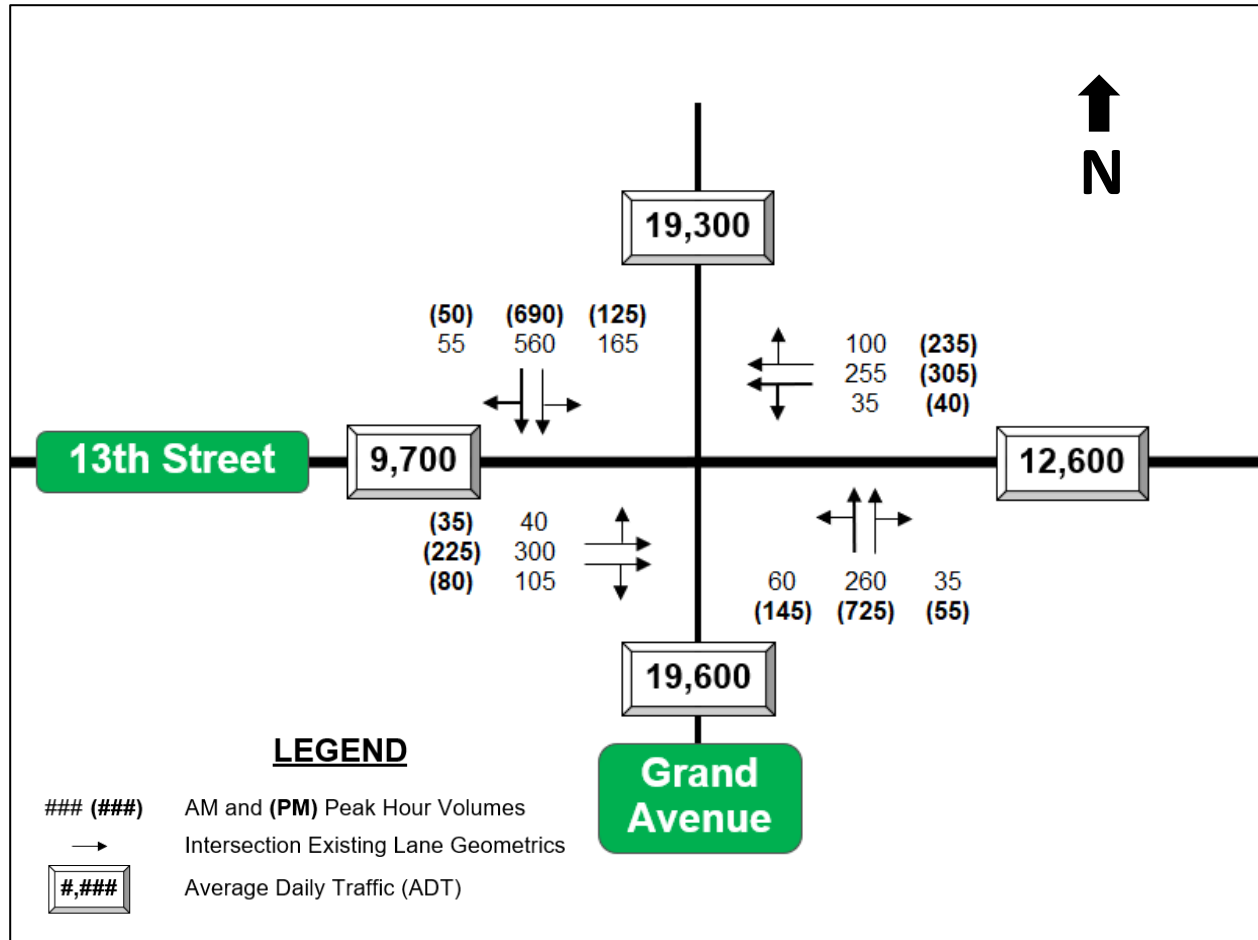


Figure 1. Year 2045 Traffic Forecasts

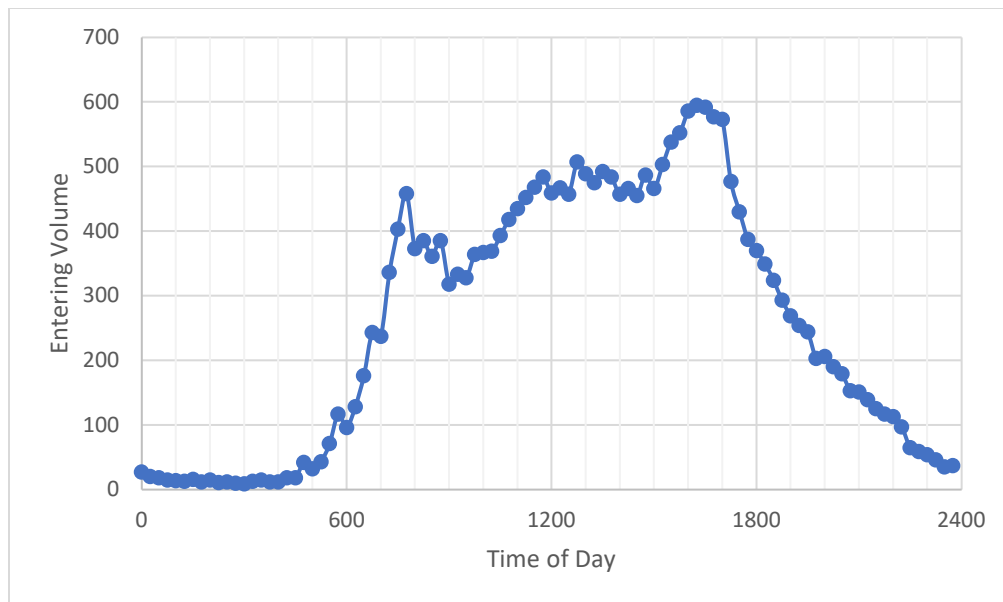


Figure 2. 13th Street & Grand Avenue 2021 24-Hour Traffic Count (15-Minute Intervals)

Synchro Operations Analysis

Base signal timings (minimum green, yellow, red times) used in the Synchro analysis match current signal timing information at the intersection with assumptions for left-turn phases based on other locations in Ames. Coordinated signal timings along Grand Avenue were modeled for Alternatives A and C to capture platooning of traffic and coordinated operations between the signal at 13th Street and adjacent signals on Grand Avenue. Coordinated signal timings were not used for Alternative B since the split phase operations in all direction would require a longer cycle length less compatible with adjacent signals.

AM and PM peak hour operations analysis results for the intersection alternatives are summarized in **Table 2**. For reference, **Table 2** also provides operational analysis results for year 2021 and year 2045 no-build conditions from the Grand Avenue Intersection Improvements Study. For year 2045 AM peak hour volumes, all alternatives would operate acceptably (Alternative B would operate at level of service (LOS) D but may be considered acceptable during peak hour conditions). Without any improvements, operations during the year 2045 PM peak hour are expected to approach capacity (capacity is LOS E). Alternative A is expected to provide significant improvement over no-build conditions. This is due to the added left-turn lanes in all directions and improved signal efficiency of operating opposing Grand Avenue through traffic concurrently. Alternatives B and C are expected to operate at capacity during the year 2045 PM peak hour with queues extending 700-1,000 feet on Grand Avenue in both directions. Based on the traffic count data from 2021 showing the PM peak lasting 1 ½ - 2 hours, the intersection may operate at capacity for multiple hours during the 2045 afternoon period with Alternatives B and C. Queue extents for each alternative during the 2045 PM peak hour, which is the worst case of the two peak hours, are also shown in **Figure 3**.

A summary of emissions at the intersection were also reported from Synchro and are provided in **Table 3**. Similar to the operations results, Alternative A would provide lower emissions than the no-build condition and Alternatives B and C. During the 2045 PM peak hour, total intersection emissions with Alternative A are expected to be about 35% lower than no-build or Alternative C and about 45% lower than Alternative B.

Table 2: 13th Street & Grand Avenue Intersection Operations Results

Intersection Lane Group			Lanes	AM Peak Hour			PM Peak Hour		
				Delay (s)	LOS	95th Q (ft)	Delay (s)	LOS	95th Q (ft)
Year 2021 (Existing) Conditions									
Overall Intersection				26.4	C		41.2	D	
Eastbound	Left-Through-Right	2		28.6	C	144	44.7	D	177
Westbound	Left-Through-Right	2		25.6	C	108	41.6	D	249
Northbound	Left-Through-Right	2		30.7	C	134	39.2	D	482
Southbound	Left-Through-Right	2		23.8	C	252	41.9	D	460
Year 2045 No-Build									
Overall Intersection				32.8	C		53.0	D	
Eastbound	Left-Through-Right	2		34.0	C	223	51.7	D	218
Westbound	Left-Through-Right	2		32.0	C	192	54.7	D	340
Northbound	Left-Through-Right	2		38.8	D	195	50.9	D	561
Southbound	Left-Through-Right	2		27.7	C	361	54.5	D	547
Year 2045 Alternative A: Widen Intersection with Left-Turn Lanes All Directions									
Overall Intersection				21.2	C		19.0	B	
Eastbound	Left	1		21.6	C	36	22.5	C	26
Eastbound	Through-Right	2		35.2	D	148	28.7	C	103
Westbound	Left	1		21.5	C	33	21.8	C	37
Westbound	Through-Right	2		31.3	C	125	25.9	C	143
Northbound	Left	1		9.0	A	41	7.9	A	49
Northbound	Through-Right	2		16.7	B	108	17.2	B	284
Southbound	Left	1		7.3	A	47	9.8	A	42
Southbound	Through-Right	2		13.2	B	235	14.5	B	276
Year 2045 Alternative B: No-Build with Split Phase All Directions									
Overall Intersection				51.5	D		79.5	E	
Eastbound	Left-Through-Right	2		53.6	D	260	79.5	E	244
Westbound	Left-Through-Right	2		51.4	D	223	81.8	F	#425
Northbound	Left-Through-Right	2		52.6	D	208	79.9	E	#696
Southbound	Left-Through-Right	2		49.8	D	#483	77.6	E	#646
Year 2045 Alternative C: Road Diet to Three-Lane Roadways									
Overall Intersection				34.1	C		62.2	E	
Eastbound	Left	1		19.0	B	35	27.7	C	41
Eastbound	Through-Right	1		54.9	D	#399	38.7	D	304
Westbound	Left	1		19.5	B	32	24.4	C	45
Westbound	Through-Right	1		42.3	D	#323	68.5	E	#699
Northbound	Left	1		13.4	B	23	45.9	D	113
Northbound	Through-Right	1		24.0	C	236	72.8	E	#939
Southbound	Left	1		10.7	B	67	47.1	D	#143
Southbound	Through-Right	1		30.7	C	#599	65.5	E	#870

Source: Synchro 12 completed by HDR, 2024.

indicates over-capacity conditions and queuing may be longer.



Figure 3. 13th Street & Grand Avenue Intersection Approach 95th Percentile Queue Extents (2045 PM Peak Hour)

Table 3: 13th Street & Grand Avenue Intersection Emissions Results

Scenario	CO (g/hr)	NO _x (g/hr)	VOC (g/hr)	Total (g/hr)
AM Peak Hour				
Year 2021 (Existing) Conditions	2,107	410	488	3,005
Year 2045 No-Build	2,718	529	630	3,877
Year 2045 Alternative A: Widen Intersection with Left-Turn Lanes All Directions	2,238	435	518	3,191
Year 2045 Alternative B: No-Build with Split Phase All Directions	3,309	644	767	4,720
Year 2045 Alternative C: Road Diet to Three-Lane Roadways	2,705	527	626	3,858
PM Peak Hour				
Year 2021 (Existing) Conditions	3,736	727	865	5,328
Year 2045 No-Build	4,790	932	1,111	6,833
Year 2045 Alternative A: Widen Intersection with Left-Turn Lanes All Directions	3,179	619	738	4,536
Year 2045 Alternative B: No-Build with Split Phase All Directions	5,842	1,137	1,353	8,332
Year 2045 Alternative C: Road Diet to Three-Lane Roadways	5,067	985	1,174	7,226

Additional Considerations

Beyond the Synchro operations analysis there are some additional considerations related to the alternatives that were reviewed and are summarized below.

Pedestrian Accommodations

The Grand Avenue Intersection Improvements Study documented pedestrian improvements at the 13th Street & Grand Avenue intersection to include a shared-use path along the west side of Grand Avenue and leading pedestrian interval (LPI) for signalized pedestrian movements at the intersection. These improvements could be implemented with Alternatives A, B and C. Pedestrian crossing distances would be shortest with Alternative C and longest with Alternative A. Pedestrian wait times would be longest with Alternative B due to the longer cycle length needed for split phasing and operating one crossing at a time (concurrent with adjacent signal phase). Pedestrian wait times would be shortest with Alternative A due to being able to operate a lower cycle length to accommodate vehicular demand.

Traffic Diversion

It is likely that traffic on Grand Avenue would divert to alternate routes to avoid high delay at the 13th Street intersection with Alternative B or C. Traffic diversion from arterial roadways to neighborhood streets can occur when delays on arterial roadways yield a longer trip time than what is experienced along a route that uses neighborhood streets with minimal or no stop control. This diversion increases

vehicle, pedestrian and bicycle conflicts along roadways that are often used to accommodate safe and efficient movement of vulnerable road users, particularly recreational users that use these streets to reduce their exposure to vehicles. Diverted traffic onto neighborhood streets may also be accompanied by speeding of drivers trying to make up time along their diverted route.

Using the Alternative C Synchro model, a sensitivity test was conducted to determine the amount of Grand Avenue traffic that may need to divert to alternate routes for acceptable operations at 13th Street & Grand Avenue. A 20% diversion of PM peak hour traffic on the Grand Avenue approaches to 13th Street (about 350 vehicles) would result in LOS D operations. A 30% diversion of Grand Avenue PM peak hour traffic (about 500 vehicles) would result in LOS C operations. Alternate north/south routes to Grand Avenue where traffic would divert likely include Duff Avenue, Clark Avenue and Northwestern Avenue. Separate evaluation would be needed to determine the suitability of these corridors to accommodate any diversion of traffic from Grand Avenue.

High delays or difficulty turning left from a shared lane at the intersection may lead to some drivers using surrounding neighborhood streets as a cut through route to avoid the 13th Street & Grand Avenue intersection. Adding left-turn lanes via Alternative A may reduce trip diversion onto adjacent neighborhood streets that is currently occurring or might occur in the future.

CyRide Influence

CyRide Green Route 2 travels north/south on Grand Avenue through the 13th Street intersection with far side bus stops at 13th Street (northbound buses stop on the north side of the intersection; southbound buses stop on the south side of the intersection). Bus headways are 20 minutes during weekday daytime hours.

When CyRide buses approach the intersection, other traffic often attempts to use the left through lane to avoid being stopped behind the bus on the far side of or within the intersection. Traffic making a lane change from the right lane to the left lane to avoid impact from CyRide merge into small gaps between vehicles, some of which are slowing to turn left from the shared through/left-turn lane, creating sudden braking (this behavior is based on field observation of existing conditions).

The behavior noted for vehicles making lane changes to avoid impact from CyRide buses would continue with either Alternative A or B. However, with Alternative A, Grand Avenue traffic preparing to turn left onto 13th Street would have a dedicated turn lane and sudden braking would be reduced. With Alternative C, CyRide buses would stop in the only through lane on Grand Avenue unless bus pullouts are constructed. Bus pullouts may not be preferred by CyRide, as buses can have difficulty entering the travel lane when there is a continuous stream of traffic.

Road Diet Implementation

Implementing a road diet at approaches to 13th Street & Grand Avenue (Alternative C) would likely extend a road diet along the corridors through other intersections and impact travel patterns in the area. The changes to geometry and traffic demands at adjacent intersections would impact operations at these adjacent locations.

The Federal Highway Administration (FHWA) advises that roadways with daily traffic less than 20,000 may be good candidates for a road diet¹. Many variables such as peaking of traffic during parts of the day, cross street demand, heavy vehicle traffic and access spacing influence how much daily traffic can adequately be served on a three-lane roadway. The projected daily traffic volume on Grand Avenue for year 2045 is slightly below the 20,000 threshold documented by FHWA, and about 9-10% of the daily traffic is during the PM peak hour. While the projected daily traffic on Grand Avenue is below the 20,000 threshold, analysis found that the intersection would operate at capacity during the PM peak hour due to total traffic demand and peaking characteristics at the intersection.

Conclusions

Of the three evaluated alternatives for the 13th Street & Grand Avenue intersection, Alternative A (widen the intersection by adding exclusive left-turn lanes) is the only alternative that would provide acceptable operations during year 2045 peak hours. Alternative B (no-build with split phase signal operations in all directions) and Alternative C (road diet on both roadways) are expected to operate at capacity during the year 2045 PM peak hour. Based on the traffic count data from 2021 showing the PM peak lasting 1 ½ - 2 hours, the intersection may operate at capacity for multiple hours during the 2045 afternoon period with Alternatives B or C. During the 2045 PM peak hour, total intersection emissions with Alternative A are expected to be about 35% lower than no-build or Alternative C and about 45% lower than Alternative B.

Other considerations for alternatives reviewed with the study concluded:

- Pedestrian crossing distances would be shortest with Alternative C and longest with Alternative A. Alternative C pedestrian crossing distances would be about 24 feet less than Alternative A.
- Pedestrian wait times would be longest with Alternative B due to the longer cycle length needed for split phasing and operating one crossing at a time (concurrent with adjacent signal phase). Pedestrian wait times would be shortest with Alternative A due to being able to operate a lower cycle length to accommodate vehicular demand. The maximum estimated pedestrian wait time is 85 seconds with Alternative A, compared to 135 seconds with Alternative B.
- Traffic diversion from Grand Avenue to other routes would be expected for Alternatives B and C to avoid high delay at the 13th Street intersection. This may place additional traffic on lower classification roadways, such as neighborhood streets, that are designated for safe and efficient movement of pedestrians and bicyclists. A 30% diversion of Grand Avenue PM peak hour traffic (about 500 vehicles) would result in LOS C operations for Alternative C, when no diversion would be likely. Likely diversion routes include Duff Avenue, Clark Avenue and Northwestern Avenue. Diverted traffic onto neighborhood streets may be accompanied by speeding of drivers trying to make up time along their diverted route. Adding left-turn lanes via Alternative A may reduce trip diversion on adjacent neighborhood streets that is currently occurring or might occur in the future.
- CyRide is expected to have the least impact to operations of other traffic with Alternative A since this alternative would provide multiple through lanes and dedicated left-turn lanes on Grand Avenue. Similarly, the improved operations with Alternative A would provide the least delay for CyRide buses at the intersection and more easily maintain their schedule.

¹ [Road Diet Informational Guide - Safety | Federal Highway Administration \(dot.gov\)](#)

- The projected traffic volume for Grand Avenue is near the top of the threshold listed by FHWA for consideration of a road diet and may not be suitable for this corridor with direct driveway access and crossing roadways with moderate volume.