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OHM Advancing Communities℠

Lower Town Area Mobility Study

City of Ann Arbor

March 2022

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EXECUTIVE SUMMARY

In April 2021, the City of Ann Arbor completed an extensive effort to revise and update its Comprehensive Transportation Plan (CTP). Titled Ann Arbor: Moving Together – Towards Vision Zero, it establishes goals for the City's transportation system to run efficiently today and supports the outcomes they desire in the future. The CTP identifies two key critical goals for the City of Ann Arbor: Vision Zero, and Carbon Neutrality. In addition, mobility values were determined that will guide the city's transportation decision making and investments over the next 20 years. There are five mobility values: Safety, Mobility, Accessibility for All, and Regional Connectivity.

As the City of Ann Arbor looks towards the incorporation of the Lower Town Area into the CTP the need to achieve a reasonable balance for the mobility needs of all users becomes more apparent with continued growth. Understanding how the transportation network impacts the mobility of all users will help guide the city in the identification and prioritization of system goals and improvements in this area of the city. The Lower Town Area Mobility Study investigates the needs of pedestrians, bicyclists and transit users and considers how their interests will be balanced against those traveling in passenger vehicles and the business requirements for commercial trucking and delivery.

Data Collection and Review

In order to ground the Lower Town Area Mobility Study in a full understanding of the context and plans for the community, a series of 16 planning documents, policy statements, capital project information, and transportation studies were reviewed, and a summary of findings prepared. The summary focused on the particular importance of each document to the Lower Town Study Area, whether it be policies, plans or suggested improvements. These summaries were compiled into a report that was used to inform our work for Lower Town Area safety and mobility.

A key early activity for the study team was the collection of traffic data at a series of 26 key locations throughout the Lower Town study area. Data collected at these locations consisted of vehicle, pedestrian and bicycle volumes throughout the day. To further aid in understanding of the travel patterns, we also set wi-fi MAC receivers at six locations. These devices allowed us to follow generic signals emitted by cell phones. This in turn allowed us to 'follow' the phones as drivers worked their way through the street network, so we were able to derive origin / destination (O/D) data for a part of the Lower Town street network. This data was used throughout the study process to inform the study team and the public about how traffic accesses and flows through the Lower Town Area.

Safety Analysis and Road Safety Audit

A Safety Analysis was performed as part of a Road Safety Audit (RSA) for multiple routes within Ann Arbor for the Lower Town Study. The analysis was completed to assist in identifying high crash locations, recognizing correctable problems, and evaluating potential solutions. This information was used by the RSA team as part of their process of identifying potential mitigation measures for the roads within the study area. The analysis identified 479 crashes in the 5-year study period, with the crashes relatively well distributed between 2014 and 2018, and do not indicate a trend of increasing (or decreasing) frequency. Analysis of segment crash data identified that there were a few locations of higher crash concentration on the study corridors. The most recurring crash patterns in this study are rear-ends, sideswipes, and single vehicle crashes.

Data from the safety analysis served as a key piece of information for the RSA. An RSA is a formal safety evaluation of planned or existing roadways by an independent, multidisciplinary audit team. The team looks for potential safety hazards that may affect any type of road user and suggests measures to mitigate those safety issues. RSAs help promote road safety by identifying safety issues during the planning, design, and implementation stages, promoting awareness of safe design practices, integrating multimodal safety concerns, and considering human factors.

Concerns identified by the RSA team were grouped and prioritized based on observed and perceived crash frequency and the anticipated and observed severity of crashes resulting from each safety issue class. The various safety deficiencies discovered during the Lower Town RSA fell into three risk categories C, D and E. Significant safety concerns include:

- Pedestrian infrastructure gaps on Traver Road, Broadway Street and Barton Drive
- Speed management concerns on Division Street, Broadway Bridge, Pontiac Trail, Plymouth Road
- Traffic Congestion at Barton and M-14, Barton at Pontiac Trail, Railroad Crossings, Broadway Bridge, and Maiden Lane at Fuller
- Bicycle Infrastructure obstacles, transitions, and wayfinding
- Pavement condition on Traver Road, Broadway Street and Barton Drive
- Traffic control device maintenance

The balance of the RSA report identified various alternatives, anywhere from two to four, for specific locations in the study area that were considered particularly problematic, whether from safety or other reasons. These special locations were:

- Pontiac Trail at Moore St / Longshore Dr
- The 'downtown' area encompassing Maiden Ln, Wall St, Swift St, Moore St, and Canal St
- The junction of Broadway St, Division St, Beakes St, Detroit St, High St, Carey St, and Summit St.
- Fuller Rd at Maiden Ln / Medical Center Dr
- Northside STEAM School

Pedestrian & Bicycle Existing Condition Audit

The analysis tools used for non-motorized modes were the Pedestrian Environmental Quality Index (PEQI) and Bicycle Environmental Quality Index (BEQI). They are both based on observational field survey to describe the pedestrian and/or bicycle environment and incorporate data collected on intersection safety, traffic, street design, land use and perceived safety.

The PEQI results indicate that the majority of street segments provide basic or reasonable pedestrian conditions with the exception of segments where no pedestrian facility (i.e. sidewalk) is provided. Based on the PEQI scores, six out of the eight signalized intersections within the study area provide reasonable pedestrian conditions. Many of the stop-controlled intersections were rated as poor due to missing curb ramp or crosswalk features.

The BEQI results indicate that all the street segments provide basic or reasonable bicyclist conditions except for a short segment on Longshore Drive south of Barton Drive. This segment is an unpaved road consisting of horizontal curves obstructing the line of sight. All the intersections, signalized and unsignalized, provide basic bicyclist conditions.

Pedestrian Crossing Analysis (NCHRP 562)

The uncontrolled crossings within the Study Area were evaluated in accordance with the National Cooperative Highway Research Program Report (NCHRP) 562. This evaluation allows for the identification of a recommended pedestrian crossing treatment for existing locations and the identification of new locations where such crossings are needed.

A total of 31 existing pedestrian crossings were evaluated. This number is a fraction of the total pedestrian crossings in the study area. Excluded from the evaluation were those at intersections under traffic signal control, as well as those that represent the crossings of two local streets. Examples of each would be Broadway St at Swift St and Chandler Rd at Indianola Ave, respectively. For the former type locations, the Ann Arbor set of design guidelines do not apply, and for the latter, there is no usage data for vehicle volumes and pedestrians to make for a meaningful analysis.

From the evaluation, we found a variety of locations had deficiencies. The following are locations where high visibility crosswalk markings should be installed:

- Across Barton Dr at Starwick Dr.
- Across Pontiac Trail at Montana Way
- Across Pontiac Trail at Polson St
- Across Traver St at Moore St

There are four locations where new pedestrian crossings, with high visibility crosswalk markings should be provided. They are:

- Across Pontiac Trail at Skydale Dr
- Across Pontiac Trail at Rudolf Steiner School south driveway
- Across Pontiac Trail at Northside Ave
- Across Swift St north leg at Pontiac Trail

Travel Demand Analysis and Forecasting

The Travel Demand Model (TDM) maintained by the Southeast Michigan Council of Governments (SEMCOG) was reviewed to understand more about the origin, destination and intended routes of the vehicular travel in the Lower Town Study Area. In addition to the existing travel patterns the TDM was used to review forecasted demand patterns in future year scenarios.

The TDM model indicates that of the traffic specifically traveling to and from Lower Town, approximately 60% are Ann Arbor based and 40% are from outside Ann Arbor. Of the current trips using the transportation network in Lower Town, 45% are trips destined to or from Lower Town and 55% of the trips are using the transportation network to pass-through Lower Town to other city destinations.

One location of particular interest for this analysis is the eastbound Barton Drive approach at the Pontiac Trail intersection during the AM peak period. It was found that only 24% of the traffic traveling on EB Barton at Pontiac Trail are traveling to the Lower Town district. Most of these trips have destinations outside Lower Town. In fact, of 95% of the pass-through trips are traveling to parts of Ann Arbor other than Lower Town. The remaining 5% are passing through the Lower Town district and beyond the limits of Ann Arbor (4% to Washtenaw County and 1% to other SE Michigan).

Having utilized the SEMCOG TDM to demonstrate the ability to trace travel patterns, the next logical step was to develop a 2040 horizon year forecast for use in the operational analysis of specific locations in the transportation network. The SEMCOG TDM already is premised on anticipating developments that will result in changes to population and the number of jobs. Developments in the process of seeking approval

from the city were individually reviewed to verify that the generated traffic was accounted for in the projections.

Existing Conditions Microsimulation (Capacity) Analysis

Simulation models were prepared for the existing conditions. Once completed, the average delay could be determined at the various intersections, be it for individual movements, approaches or for the whole intersection. This allowed for the identification of capacity deficiencies for each intersection movement as well as the intersection as a whole. Under existing traffic volumes, multiple study intersections have some form of operational deficiency that could be addressed.

To resolve these deficiencies, and address identified safety and mobility concerns, several alternatives were modeled for select intersections in the Lower Town Area. Alternatives were created for the intersections of:

- Barton at Plymouth
- Barton at Pontiac
- Barton at M-14
- Beakes at Broadway
- Broadway at Maiden and Moore
- Pontiac at Moore and Longshore

Alternatives range from adding a turn lane to reconfiguring the intersection. The alternatives are based on the current AM and PM peak conditions. Three signal warrant analyses were also prepared, for M-14 EB off ramp at Barton, Pontiac Trail at Dhu Varren, and for Pontiac Trail at Arrowwood.

Public Engagement

As is typical for transportation planning studies, the Lower Town Area Mobility Study included a substantial public engagement component. However, this portion of the work was significantly complicated when the COVID-19 pandemic curtailed the ability to elicit in-person participation from the residents of Ann Arbor. So, while some of the initial outreach did involve face to face interactions, the project team needed to adapt and rely on other outreach methods that conformed to the social distancing requirements to deal with the pandemic.

As initially conceived, the public involvement would focus on a series of interviews with stakeholders, then transition to four public meetings. The stakeholder meetings were held in-person in December 2019, prior to the onset of the pandemic, and included interviews with 10 different stakeholder groups. These meetings allowed the project team to identify common mobility themes. The issues raised included concerns for traffic congestion, speed and safety, the potential impacts from new development, and desired improvements and expansion to multi modal transportation in the study area.

A series of 4 public meetings was held throughout the study duration. These meetings were held after the social distancing requirements due to the COVID-19 pandemic and were conducted in a virtual format by way of video conferencing. Topics covered in the public meetings included general study updates as well as more detailed information on the studies goals, solutions, and recommendations. Each meeting included opportunity for questions and open discussion. Attendance at these meetings varied. When meeting attendance was low, or the subject matter was particularly detailed, additional opportunities for interaction with the project team were provided by way of open office hours. The office hours were also held in a virtual format.

Beakes St / Broadway St / Division St

The one-way pair of Division St (NB) and Beakes St (SB) join for 2-way movements at Broadway St. In addition, there are further junctions with Summit St (2-way movements), Detroit St (2-way including a special one-way connection opposite Summit St), Carey St (2-way), and High St (1-way). Summit, Carey and High provide access to and from Depot St. This location has many conflicts which relates to the relatively high number of crashes that occurs in this area annually. While residents are already familiar with this junction of seven streets, including the unique way the 1-way streets fit into the puzzle, it is a confusing junction for motorists not familiar with the area. From a human factors viewpoint, the roadway geometry and density of connections results in an abnormally high information workload for all users.

Potential alternatives were developed for this location with the fundamental goal of reducing the number of conflicts. Where possible, conflicts of pedestrians crossing vehicle paths and vehicles crossing other vehicle paths were a priority for reduction.

Each of the alternatives developed represent a compromise in terms of cost, improving safety, restricting movements and the resultant changes to travel patterns. With all this considered, OHM recommends that the City take steps to immediately implement improvements to expand facilities for pedestrians and bicyclists (Option E) as a short-term measure. We also endorse a more involved reconfiguration of the intersection to simplify vehicular movements and reduce conflict points (Option D) as the long-term solution that represents the best balance between the competing interests. We recommend that an opinion of probable cost be developed for Option D for inclusion in the City's Capital Improvement Plan.

Longshore Dr/ Moore St / Pontiac Trail

Moore St and Pontiac Trail / Swift St form a one-way pair that join for 2-way movements on Pontiac Trail northeast of their intersection with Longshore Dr. The primary movements by vehicle volumes are NW Moore turning right onto NB Pontiac Trail and SB Pontiac Trail continuing south through the intersection; namely traffic related to the one-way pair. The traffic controls reflect this primacy of movements. The angle Moore joins the intersection results in NW Moore right turning vehicles taking the corner far faster than prudent to limit the risks to pedestrians crossing the north leg of the intersection. It is also confusing to drivers that the right turns are free flow while the hard left turns to SB Pontiac Trail and mild left turns to Longshore are under STOP controls.

Potential alternatives were identified to reduce not just the number of conflict points but improve the geometry to be more self-evident to drivers what controls were related to each of the movements. Fundamentally, the options look to improve pedestrian safety for their crossings of the intersection legs.

We recommend the City implement Short Term improvements to restripe Moore Street to add a bicycle lane carrying onto NB Pontiac Trail and change the intersection control for Moore at Pontiac to a YIELD Control (Option 2). Regarding the longer-term improvements, each of the alternatives represents compromises in terms of cost, improving safety, restricting movements and the resultant changes to travel patterns. With all this considered, OHM recommends the construction of an urban compact roundabout with Moore Street either remaining one-way or converted to two-way traffic (Option C or D). These represent the best balance between the competing interests. We recommend that an opinion of probable cost be developed for Option C for inclusion in the City's Capital Improvement Plan.

Barton Dr / Pontiac Trail

Barton Dr and Pontiac Trail is a signalized intersection. Both roads are generally two-lanes, but Pontiac Trail has left turn lanes provided at the intersection. On-street bike lanes exist on Barton Dr east of Pontiac Trail, but not to the west. Rather, on-street parking is allowed on Barton to the west of Pontiac Trail. Bike lanes are provided north and south along Pontiac Trail but are eliminated through the intersection where the left turn lanes are developed. Traffic counts (capacity calculations) and direct field observations have pointed to congestion issues during the commuter peak periods, especially in the morning. In the a.m. period, significant backups occur for both eastbound and southbound approaches.

There are competing interests at this intersection that cannot be served with conventional traffic signal timing or geometric improvements due to the limited available road ROW. Signalized and roundabout options were evaluated based on the needs of all users. OHM weighed the benefits of these options and found that none of the individual options would solve the long term demands of all users at the intersection. Rather than identify a geometric change to the intersection, it is believed that this intersection would be best served by implementing Traffic Demand Management techniques. It was realized that the issues at the intersection are primarily related to the peak hours. In shifting intersection demand to be spread throughout the day, the intersection could realize the most congestion relief.

Dhu Varren Rd / Pontiac Trail

Dhu Varren Rd and Pontiac Trail currently operates as a two-way STOP controlled intersection, with the controls applying to Dhu Varren. On-street bike lanes exist on Pontiac Trail through the intersection. Bike lanes begin on Dhu Varren east of the intersection but do not extend into the intersection. Traffic counts and direct field observations have pointed to congestion issues and high speeds during the commuter peak periods, especially in the morning. When traffic signal volume warrants are considered, this location meets the criteria for the installation of a signal.

Current issues at this intersection involve vehicle safety and delay concerns, given the dearth of facilities for other modes of travel. Any potential solution should anticipate a future where additional facilities are provided for bicyclists and pedestrians.

OHM endorses the construction of an urban compact roundabout (Option B) as representing the best option to meet the needs of all users. A roundabout will facilitate the change of roadway character from rural to urban as users enter the city, while helping to reduce speeds, and provide congestion relief for Dhu Varren traffic during peak periods. We recommend that an opinion of probable cost be developed for Option B for inclusion in the City's Capital Improvement Plan.

Broadway St / Maiden Ln / Moore St / Plymouth Rd

Broadway St at Plymouth Rd / Maiden Ln /Moore St is a signalized intersection with left turn phasing. Broadway and Plymouth are 5-lane roads with center lanes for left turns, Maiden Lane is a 3-lane with a center left turn lane, and Moore has two northwest bound travel lanes, one parking lane along its north side and is one-way to the northwest. Current traffic counts (capacity calculations) and direct field observations have pointed to congestion issues during both commuter peak periods, but especially in the evening.

There are competing interests at this intersection that tend to be mutually exclusive with conventional measures due to the limited road ROW that is available. Two options have been evaluated in detail for this location, a multi-lane roundabout option and a signalized option, where Moore Street could be

converted to two-way in both options. The roundabout option is anticipated to have the best safety performance, with a 57% reduction in conflict points. The roundabout option would include enhanced pedestrian protection by way of Rectangular Rapid Flash Beacons (RRFB) or Pedestrian Hybrid Beacons (PHB) at the pedestrian crossings. The cons for the roundabout include the need for ROW, potential reduced parking on Moore Street and if PHB's are incorporated, vehicles operations will be impacted during signal activation. The signalized option provides a more traditional intersection but does not provide improved safety or speed reduction.

OHM endorses the signalized intersection option with a 2-way conversion for Moore St. While this option shows a slight degradation in delay at the intersection, the overall improvement to the Lower Town Area will be substantial. In turning Moore St to a 2-way roadway, traffic from the north, with a destination of the University of Michigan medical campus, will no longer need to weave down Pontiac Trail, to Swift, onto Broadway and then turn at either Wall St or Maiden Ln. Travel patterns will be simplified with the direct connection from Pontiac Trail to Moore St, which becomes Maiden Ln. The addition of the previously recommended roundabout at Pontiac / Moore / Longshore intersection will further facilitate traffic movements onto the converted Moore St.

While the roundabout option showed promise for vehicular operations, these didn't factor in the need for pedestrian signals to cross the roundabouts multi-lane approaches. In addition, the roundabout option was not looked upon favorably during team meetings with the city or with the public, primarily due to past experience in the city with multi-lane roundabouts.

Barton Dr / Plymouth Rd

Barton Dr at Plymouth Rd is a signalized tee intersection. Plymouth is a 5-lane road with center lane for left turns, Barton Dr is a 3-lane road with a center left turn lane. A dedicated left turn signal phase is provided for the northeast bound Plymouth Rd movement to Barton. Further, there is a right turn signal overlap for Barton. Current traffic counts (capacity calculations) and direct field observations have pointed to congestion issues during the a.m. commuter peak periods for Barton Dr. The congestion is time limited to the a.m. peak, so extraordinary or expensive options are not likely to be cost effective. Only one option, providing southbound dual left turn movements, has been developed that may be viewed as balancing the benefits with a modest cost to implement.

Ultimately, the option to modify this intersection to provide southbound dual left-turn movements was rejected due to confusing geometry and the potential for side-swipe crashes with the dual left turn configuration. The railroad crossing the north leg further complicates the intersection. Based on input from both public and team meetings, the option to change this intersection was not pursued.

Plymouth Rd from Broadway St to Barton Dr

This corridor was identified as having speeding concerns. This 5-lane section is already planned to be refurbished by the City with narrowed lanes (10') to add an on-street bike lane for SW bound cyclists. Beyond these changes, which are already in the works, we recommend installing speed actuated (radar) warning signs for both NE and SW Plymouth Rd. From the RSA report, we recommend that a roundabout be constructed at the intersection of Broadway St /Maiden Ln / Moore St / Plymouth Rd. Finally, we urge that a portion of the center lane be removed in favor of a raised median island, to provide a refuge for a new pedestrian crossing to provide access to an AAATA bus stop along SW Plymouth. This crossing should include RRFB signals and a gateway treatment.

Pontiac Trail from Swift St to Dhu Varren Rd

This corridor was identified as having speeding concerns. There are four locations along this corridor that would benefit from the construction of roundabouts, Pontiac Trail at Moore St /Longshore St, at Barton Dr, at new residential development (Village of Ann Arbor) located north of Skydale Dr, and at Dhu Varren Rd. There are five new pedestrian crossings identified, at Swift St, at Northside Ave, at the south drive of Rudolf Steiner School, at Skydale Dr, and at Montana Way. We recommend the crossings at Rudolf Steiner School driveway and at Montana Way include gateway treatments. Gateway treatment should also be added to the existing pedestrian crossing at Taylor St. There is a relatively new crossing at St. Regis Dr; this location should be modified to include a median island in place of the center lane on the north leg of the intersection. Finally, there are two locations along Pontiac Trail where radar speed signs should be installed. They are SB north of Indianola Ave, and NB north of Starwick Dr.

Division St from Catherine St to Beakes St / Broadway St

This corridor was identified as having speeding concerns. Currently one-way NB, on-street parking is allowed along the west side of Division St. This corridor would benefit by having curb extensions (neckdowns) provided at three locations to reduce the crossing distances for pedestrians and better delineate the parking lanes. These locations are the northwest corner of Division at Catherine St, the northwest corner at Kingsley St, and the southwest corner at Detroit St. This latter location would be done along with changes to the junction of Division at Beakes St / Broadway St. To see what we are proposing, refer to Section IV.A of this report (Study Alternatives: Beakes / Broadway / Division). This also includes providing a new pedestrian crossing with RRFB signals located across Division north of Detroit. Finally, we are recommending the installation of a radar speed sign for NB Division located south of the intersection with Carey St.

Broadway St from Division St/Beakes St to Plymouth Rd

This corridor was identified as having speeding concerns. The study explores the reconfiguration of the junction of Beakes, Broadway, and Division. If implemented, the changes should contribute significantly to speed management along this street. We are also recommending the installation of a radar speed sign for SB Broadway, to be located just south of the intersection with Swift St. There should also be a curb extension for the southwest corner of Broadway at Swift.

Traver St from Moore St to Barton Dr

This corridor was identified as having speeding concerns. Traver Rd is a non-major (local) street, which allowed us to consider the use of speed humps. There are already a few installed but the spacing between them is greater than recommended by most safety organizations. We recommend that two more be constructed, the first about midway between Pear St and the Ann Arbor Railroad grade crossing and the other south of Bowen St. Gateway treatment should be added to the existing pedestrian crossing of Traver south of John A Woods Dr. Finally, we recommend that the roadway segment of Traver between John A Woods Dr and Barton Dr be narrowed by eliminating the on-street parking against the northwest side of the street and adjusting the curb. Depending on how far the curb line is shifted, there would then be room for either a multi-use pathway (10’ wide) or a standard width sidewalk (5’) and an on-street bike lane for southwest bound cyclists. The on-street parking along the southeast side of Traver should be allowed to remain in either case. Sidewalk shall be provided for both sides of the street.

Pedestrian Recommendations

In addition to the locations described above, the study identified challenges and opportunities throughout the study area. Study recommendations anticipated to address pedestrian network concerns include the following:

- RRFB
- Gateway signs
- Pedestrian crossing signs
- Street Trees
- Driveway channelization
- Eliminate pedestrian protrusions
- Encourage flex shift hours
- Fill in railing gaps
- Fill in sidewalk gaps
- High emphasis crosswalk treatments
- Improved street lighting
- Increase greenbelt separation
- Install pathway lighting
- Construct roundabouts
- Install sidewalk
- Add a leading pedestrian interval
- Narrow traffic lane widths
- Grade separate rail crossing
- Provide pedestrian ramps
- Speed management
- Parking reconfiguration
- Countdown pedestrian signal heads
- Upgrade routes for ADA compliance
- Widen pedestrian routes

Bicycle Recommendations

In addition to the locations described above, the study identified challenges and opportunities throughout the study area. Study recommendations anticipated to address bicycle network concerns include the following:

- Bike lane signing
- Eliminate bicycle route protrusions
- Enforce bike lane blocking
- Electronic speed warning radar
- On street bike lanes
- Intersection reconfiguration
- Bike boulevard
- EVehicle and EBike charging stations
- Grade separate rail crossing
- Widen bike routes

Transit Recommendations

In addition to the locations described above, the study identified challenges and opportunities throughout the study area. Study recommendations anticipated to address transit network concerns include the following:

- Eliminate parking/bus stop conflicts
- Improve transit frequency
- Improve transit reliability
- Increase frequency of transit stops
- Install bus stop pads
- Connect bus stop pads to sidewalk
- Provide Park N Ride for commuters
- Provide transit signal priority
- Upgrade stops to be ADA compliant

Vehicle Recommendations

In addition to the locations described above, the study identified challenges and opportunities throughout the study area. Study recommendations anticipated to address vehicle network concerns include the following:

- Driveway channelization
- Encourage flex shift hours
- Guardrail installation
- Pavement marking maintenance
- Sign maintenance
- Electronic speed warning radar
- Alternate route notification signs
- Construct roundabouts
- Install new traffic signal
- Roadway signing

- Modernize traffic signal to box span
- Pave shoulder
- Convert two-way street to one-way
- UM Medical Center alternate route
- EVehicle and EBike charging stations
- Provide left turn lanes
- Speed management
- Transit signal priority
- Reconfigure intersection
- Reconfigure parking
- Repair guardrail
- Repair pavement
- Adjust roadway alignment
- Update signal timing

Conclusions

This report has been prepared to assist the City of Ann Arbor in the identification and actualization of opportunities to improve safety and mobility within the Lower Town study area. The report is based on a variety of efforts to evaluate safety within the study area, make observations of actual field conditions, document existing conditions through data collection and other information available at the time of the study. The recommendations contained herein were arrived at through collaboration between the OHM project team and the City of Ann Arbor. Countless project and public meetings were used to guide the decision-making process. The recommendations included in this report are for consideration by the City and are in no way intended to preclude the City in their deliberations as to whether to accept the recommendations. This report also does not preclude the identification of additional issues pertaining to safety or mobility by City staff, or the emergence of new issues over time.

I. RECAP OF GOALS & VALUES FROM COMPREHENSIVE TRANSPORTATION PLAN

In April 2021, the City of Ann Arbor completed an extensive effort to revise and update its Comprehensive Transportation Plan (CTP). Entitled **Ann Arbor: Moving Together – Towards Vision Zero**, it establishes goals for the City's transportation system to run efficiently today and supports the outcomes they desire in the future. Through a process that involved thousands of residents, city staff, community groups, advocates, and partner agencies, the CTP identifies two key critical goals for the City of Ann Arbor:

- Vision Zero: No one dies or is seriously injured in crashes on Ann Arbor's streets. By 2025, the City will have all worked together to eliminate fatalities and serious injuries resulting from traffic crashes.
- Carbon neutrality: The transportation system contributes zero emissions towards climate change. By 2030, the City will have transitioned to a carbon-neutral transportation system.

Five mobility values were determined that will guide the City's actions toward fulfilling these goals. These mobility values are the foundation for the ideas, actions, projects, and policies described in **Ann Arbor: Moving Together** and will guide the city's transportation decision making and investments over the next 20 years. The values are:

- Safety – Ann Arbor is a safe city where everyone participates in creating an environment in which people feel confident and comfortable traveling.
- Mobility – Ann Arbor prioritizes moving people and goods efficiently; making it easier for people to choose sustainable modes of transportation.
- Accessibility for All – In Ann Arbor, people of all abilities, ages and stages of life, income, races, cultures, and ethnicities have equitable access to the places where they live, work, and play.
- Healthy People & Sustainable Places – Ann Arbor's transportation system supports a healthy population, sustainable environment, and robust economy, while celebrating and enhancing a unique quality of place.
- Regional Connectivity – Ann Arbor works to expand travel options throughout the region and integrate its transportation system with wider regional networks.

Importantly, the CTP details 22 key strategies to be pursued over the coming years to address the mobility challenges in a sustained, systemic way. **Ann Arbor: Moving Together** includes information on how the plan's recommendations can become reality, including funding sources, and estimated capital investment levels. The plan also creates a framework, including performance measures and evaluation procedures, for regularly reporting on progress to ensure transparency and ensure the actions that are taken are leading to the desired outcomes.

II. SOURCES OF IMPROVEMENT CONCEPTS AND ALTERNATIVES

A. Existing City Planning Documents

The City wished to ensure that the Lower Town Area Mobility Study would be grounded in a full understanding of the context and plans for the community. Guided by the City, we collected a series of planning documents, policy statements, capital project information, and transportation study results from relevant development projects. We then summarized the road user needs and mobility challenges identified in those existing documents as they applied to Lower Town. A total of 16 documents were considered. These included:

- City Master Plan – Land Use Element 2009
- City Master Plan – Transportation Plan Update 2009
- City Master Plan – Non-motorized Transportation Plan 2007 and 2013 Update
- City Master Plan – Sustainability Framework 2013
- City Parks and Recreation Open Space (PROS) Plan 2016-2020
- City Capital Improvements Plan
- North Main Huron River Corridor Vision
- Northeast Area Transportation Plan 2006
- The Treeline – Allen Creek Urban Trail Master Plan
- Connector Feasibility and Alternatives Analysis Studies
- Fuller East Medical Intersection Improvement Analysis
- City Council Resolution Regarding Non-Motorized Path Improvements
- University of Michigan Medical Center Campus Master Plan
- University of Michigan North Campus Master Plan
- Ann Arbor Area Transportation Authority (AAATA) Transit Improvement Plan
- Amtrak Ann Arbor Station Environmental Assessment, Purpose & Need Statement, Appendixes et al. (2014)

After each document was reviewed, a summary of our findings was created. The summary focused on the particular importance of that document to the Lower Town Study Area, whether it be policies, plans or suggested improvements. These summaries were compiled into a report that was provided to the study team for their use, to inform our work for Lower Town Area safety and mobility. This report can be found in Appendix A.

B. Traffic Data Collection

A key early activity for the study team was the collection of traffic data at a series of key locations throughout the Lower Town study area. This took the form of using video data capture from which vehicle, pedestrian and bicycle volumes were obtained. The locations considered key included:

- US-23 SB Ramps & Whitmore Lake Rd. / Barton Dr.
- US-23 NB Ramps & Barton Dr.
- Barton Dr. & Chandler Rd.
- Pontiac Trail & Dhu Varren Rd.
- Pontiac Trail & Taylor St.
- Pontiac Trail & John A Woods Dr.
- Chandler Rd. & Argo Dr.
- Broadway Street & Maiden Lane
- Broadway St. & Wall St.
- Broadway St. & Swift St
- Broadway St. & Detroit St.
- Division St & Carey St.
- Division St & Detroit St.
- Carey St & High St

- Pontiac Trail & Argo Dr.
- Pontiac Trail & Moore St. / Longshore Dr.
- Moore St. & Traver St.
- Barton Dr. & Traver St.
- Plymouth Rd. & Barton Dr.
- Plymouth Rd. & Broadway St.
- Division St. & Kingsley St.
- Division St. & Catherine St.
- Canal St (N) & Wall St.
- Canal St (S) & Wall St.
- Maiden Ln. & Island Dr.
- Pontiac Trail & Arrowwood Trail

These locations had a minimum of 13 hours of data captured, from which we were able to identify the turning movement patterns for the a.m. and p.m. peak commuter volumes, and a midday volume for use in operational evaluations.

To further aid in understanding of the travel patterns, we also set wi-fi MAC receivers at six locations. These devices allowed us to follow generic signals emitted by cell phones. This in turn allowed us to 'follow' the phones as drivers worked their way through the street network, so we were able to derive origin / destination (O/D) data. Basically, this meant we were able to understand where drivers were coming from and going to within Lower Town. The locations used for the O/D receivers were:

- Pontiac Trail & Dhu Varren Rd.
- Moore St. & Traver St.
- Maiden Ln at Island Dr
- Barton Drive; East of US-23 NB
- Plymouth Rd. & Barton Dr.
- Broadway St. North of Detroit

All of the traffic data collected in this phase of the project is copied in Appendix B.

C. Crash Analysis

The Safety Analysis was initially performed as part of a Road Safety Audit (RSA) for multiple routes within Ann Arbor for the Lower Town Study. Routes selected for analysis included portions of Barton Drive, Plymouth Road, Pontiac Trail, Swift Street, Moore Street, Detroit Street, Broadway Street, High Street, Carey Street, Division Street, and Maiden Lane. These routes are highlighted in Figure 1. The analysis was completed to assist in identifying high crash locations, recognizing correctable problems, and evaluating potential solutions. A total of **five** years of crash data, from January 1, 2014 through December 31, 2018 was obtained from the Traffic Improvement Association's (TIA) Crash Analysis Tool (TCAT) software. The TIA provided detailed traffic crash reports (UD-10) that were reviewed for crash types, and fatal or serious injury collisions (if any).

The analysis procedure consisted of identifying the location, type, and severity of each crash. Additional information including weather and pavement conditions for each crash was then identified. This information was used by the RSA team as part of their process of identifying potential mitigation measures for the roads within the study area.

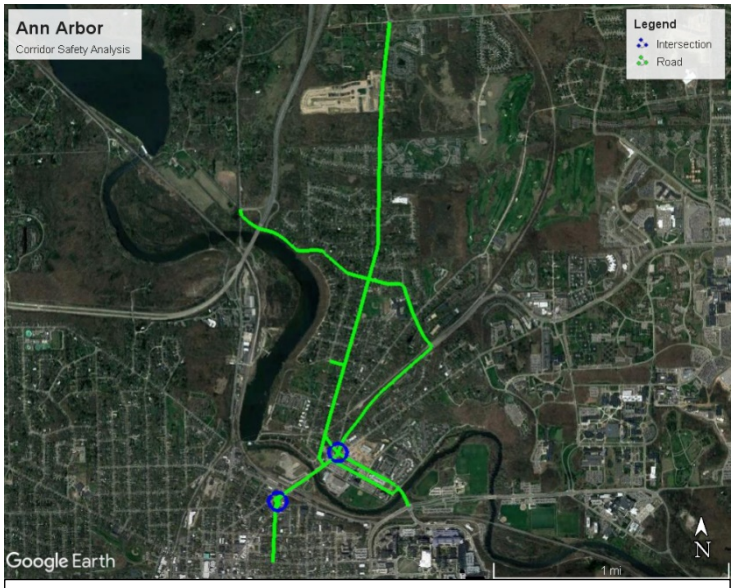


Figure 1 – Study Area with Evaluated Road Segments and Intersections Highlighted

There were 479 crashes in the 5-year study period, which represents 3% of the total amount of crashes that had occurred within the Ann Arbor City limits during this time frame. The crashes on the road segments under study did not involve any fatalities. However, 22 fatalities occurred in the rest of Ann Arbor in the five years of the study period.

Table 1 – Critical Crash Patterns for the Study Routes (Years 2014 – 2018)

	Targeted Crash Patterns								5 Year Total for Study Area (All Crash Types)	5 Year Total for Ann Arbor
	Sideswipe	Head-on	Head-on Left-turn	Angle	Rear-end	Single Vehicle	Ped / Bike	Other		
All Crashes	83	9	13	93	189	71	14	7	479	15,577
	17.3%	1.9%	2.7%	19.4%	39.5%	14.8%	2.9%	1.5%		
Fatal	0	0	0	0	0	0	0	0	0	22
	0%	0%	0%	0%	0%	0%	0%	0%		
A Injury	0	1	0	0	0	4	2	0	7	151
	0%	14.3%	0%	0%	0%	57.1%	28.6%	0%		

The 479 crashes were relatively well distributed between 2014 and 2018, and do not indicate a trend of increasing (or decreasing) frequency. Type A injuries are defined as any injury that prevents the injured person from walking, driving, or normally continuing the activities which they were capable of performing prior to the crash, examples being severe lacerations or visibly broken limbs. Many times, this level of injury require the person to be transported by ambulance to a hospital or critical care unit. Type B injuries are any injuries that are evident at the scene of the crash but do not prevent the individual from operating normally, examples being a lump on the head or abrasions. Injuries at this level are occasionally transported by ambulance. Type C injuries are any that are claimed but not visible, examples being complaints of pain or nausea.

Crash data for each study route was analyzed independently. Crash data was organized by location with each study route divided into 0.2-mile-long segments. The crash data within these segments was reviewed for patterns and areas of concern. Analysis of segment crash data identified that there were a few locations of higher crash concentration on the study corridors. The most recurring crash patterns in this study are rear-ends, sideswipes, and single vehicle crashes.

There were three major intersections in the Lower Town study area that were identified as significant concerns, warranting their own focus. They were:

- Broadway St at Moore St / Maiden Ln
- Broadway St at Beakes St / Carey St / Division St / Summit St
- Fuller Rd at Maiden Ln / E. Medical Center Dr

While crash data for roadway segments and intersections was evaluated for all typical crash patterns, a special look was undertaken to focus on those involving pedestrians and bicyclists. Specifically, a breakdown was performed for the four (4) collisions involving pedestrians and the ten (10) with bicycles to examine the severity, trends, and locations with such crashes. The full crash study can be found in Appendix C.

Road Safety Audit

The key piece of the Lower Town Study was to perform a Road Safety Audit (RSA) to understand the potential safety hazards that exist in the area and how they relate to the mobility issues in Lower Town.

An RSA is a formal safety evaluation of planned or existing roadways by an independent, multidisciplinary audit team. The team looks for potential safety hazards that may affect any type of road user and suggests measures to mitigate those safety issues. RSAs help promote road safety by identifying safety issues during the planning, design, and implementation stages, promoting awareness of safe design practices, integrating multimodal safety concerns, and considering human factors. The RSA team for the Lower Town study area was composed of transportation professionals and individuals with special skills in:

- RSA Facilitation
- Geometrics
- Human Factors
- Traffic Safety
- Traffic Operations
- Non-motorized Safety
- School Safety

The RSA team leader and team members conducted field reviews (both day and night) and prepared the audit report. Procedures in performing an RSA are detailed in the FHWA Road Safety Audit Guidelines. The RSA helped inform the recommendations made as part of the Lower Town Study, specifically those centered around safety. The process, methodology for this analysis, and data obtained throughout the study, as well as all significant findings, safety issues, and recommended mitigation strategies are detailed in the Report, which is contained in Appendix C.

A group of stakeholders were asked to attend the RSA kick off meeting to obtain their perspectives on the study area. They were candid in their voicing of issues and concerns surrounding mobility that exist in the neighborhood. Stakeholders included representatives from:

- City of Ann Arbor Engineering Department
- Ann Arbor Fire Department
- Ann Arbor Area Transportation Authority (The Ride)
- Ann Arbor Public Schools
- City of Ann Arbor Planning Department

The following issues and concerns were noted:

- Upcoming development at 841 Broadway Street and the recent Barton Green development will likely contribute to traffic and mobility issues
- Ann Arbor STEAM school had to return Safe Routes to School money due to a lack of support for sidewalks in the neighborhood (specifically, for sidewalks on Traver Road)
- Stakeholders want to make sure that the Fuller Road/Maiden Lane intersection is included in the study
- Barton Drive at M-14 is a high crash location
- Evaluation of uncontrollable crossings – both existing and proposed
- The University of Michigan Medical Campus is a major employment driver in this area with many employees traveling through Lower Town to get to work
- There is an official traffic calming request for Northside Avenue at Pontiac Trail
    - A conflict exists between arterial and residential streets
- Controversy regarding removal/loss of parking on Barton Drive and the addition of a bike lane coinciding with water main replacement project
- Only two bridges crossing Huron River exacerbate traffic and isolate northside neighborhoods

- Consider pedestrian and multi-modal friendly lighting at major intersections
- AAATA Route 23 -Maiden Lane bus is full in the morning
- On time performance of buses traveling through Lower Town suffers due to vehicle congestion
- People using the Cascades canoe/kayak/tubing area in the summer can park in the University lots at Wall Street and Broadway Street, pedestrians crossing here can be a safety issue
- Moore Street at Pontiac Trail has had requests for attention due to the odd traffic control signals here
    - There are also two slow freight trains per day that pass through this intersection
- The far side bus stop at the intersection of Moore Street and Broadway Street has a complaint about not being ADA compliant
- 1140 Broadway project is installing a new sidewalk at Plymouth Road and Broadway Street

Constraints

- Right of way at Barton Drive and Pontiac Trail – it would be difficult to widen the roadway at this intersection
- Midwest Consulting investigated the possibility of a roundabout at Barton Drive & Pontiac Trail

Planned/ Scheduled Projects

- A water main replacement and resurfacing of Barton Drive from the M-14 ramp to Pontiac Trail

Future Projects

- None mentioned

The RSA team conducted its field work in February 2020. The issues identified by the RSA team were first grouped into classes of safety issues and then prioritized using the **Prioritize Safety Issues: Risk Matrix** provided by FHWA. For each of the classes of safety issues, the team developed potential mitigation measures for review by the City of Ann Arbor. The safety issue classes were prioritized based on observed and perceived crash frequency and the anticipated and observed severity of crashes resulting from each safety issue class. As a result, each safety issue class was given a ranking from A (lowest risk and lowest priority) to F (highest risk and highest priority). The Risk Matrix is displayed in Figure 2 below and shows how each risk category is determined.

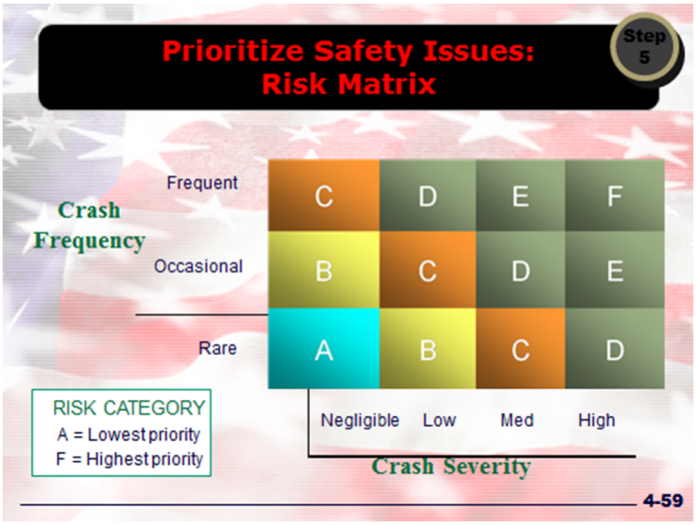


Figure 2: Prioritize Safety Issues: Risk Matrix

The various safety deficiencies discovered during the Lower Town RSA fell into three risk categories, E, D, and C. Each area with a safety deficiency identified in the Study Area is discussed below.

Crash Potential #1 (Risk Category E) – Pedestrian Infrastructure

The RSA identified gaps in the sidewalks on Traver Road, Broadway Street, and Barton Drive. Several of these key gaps would be key in serving students attending the Northside STEAM school on Barton Dr. In addition, there were a few locations without sidewalk ramps or ramps that were not compliant with current handicap accessibility standards. There were a couple of locations where pedestrian desire lines were evident (paths worn in the turf) and new sidewalk would make sense to satisfy the clear active uses.

There were fences and railings needing mending in a few locations, as well as vegetation needing to be trimmed or removed to improve sight distances for pedestrians. While few, there were some bus stop locations without a waiting pad, or the pad was not connected to the nearby sidewalk.

Figure 3: Pedestrian Walking in Roadway Due to Absence of Sidewalk

One of the key pedestrian infrastructure needs involves improving recreational users access from the remote, overflow parking to the Huron River Cascades.

Crash Potential #2 (Risk Category D) – Speed Management

There were several roadways where it was evident the vehicles were exceeding the posted speed limit. These included segments of:

- Division Street Northbound
- Broadway Bridge
- Pontiac Trail
- Plymouth Road

For these segments, a variety of measures were identified to address these concerns, including electronic speed warning systems, shifting pedestrian crossings to improve sight distance between drivers and pedestrians, and possible physical design elements to improve safety for motorists, pedestrians, and cyclists.

Figure 4: Example of radar-based speed warning system.

Crash Potential #3 (Risk Category D) – Traffic Congestion

The RSA identified several locations that experience traffic congestion either part of, or most of the day. These locations coincided with some of the sites noted by the stakeholders. One such location is Barton Drive and the M-14 interchange. Traffic seeking access to NB M-14 is delayed by the geometry of the entrance ramp, which causes backups down the ramp and onto Barton Dr. This is primarily a p.m. peak

commuter problem. But the all-way STOP at the terminus of the ramp has its own issue of significant queuing, especially in the a.m. peak commuter period.

Barton Drive at Pontiac Trail is another location, especially during the a.m. peak period. This signalized intersection does not have left turn lanes for east or westbound Barton and the conflict between EB Barton and SB Pontiac Trail results in long backups for both approaches.

There is a recurring problem with the freight operations of Ann Arbor Railroad. This company operates a twice a day train that is both slow enough and long enough to block its crossings of Barton Dr, Traver Rd and Pontiac Trail all at the same time. This causes extensive backups at all these crossings.

Beyond these issues, we noted congestion-related traffic queues for eastbound Broadway Street Bridge in the p.m. peak period, westbound Catherine Street Westbound again in the p.m. and Maiden Lane at Fuller Road essentially all day.

Crash Potential #4 (Risk Category D) - Bicycle Infrastructure

The potential issues noted for bicycle infrastructure fall into three general categories: obstacles, transitions and wayfinding. For obstacles, this relates to not having a clear, full width path available for bike users. Examples include the boardwalk along the western portion of Barton Dr having less than 10' width between railings, or numerous instances of bike lanes being blocked by rubbish receptacles.

Bike infrastructure transitions deals with the irregularities of beginning or ending of bike facilities, whether on-street lanes or separated paths. Solutions to these generally involve better signing or occasionally providing better ramps from bike lanes to pathways or back again.

Finally, there is a general lack of wayfinding for bikes throughout the study area.

Figure 5: Broadway Street bridge has poor visibility around the curve at Division Street and concrete pillars holding light poles extend too far into the travel way. Concrete fillers should be placed to eliminate the protrusions of the bridge and lighting posts, presenting a smooth barrier face to cyclists.

Crash Potential #5 (Risk Category C) – Pavement Condition

While most of the roadways in the study area exhibited relatively good pavement condition, we noted several locations with severe pavement deterioration, such as along Traver Rd. There were other problem spots on Broadway St and Barton Dr.

Crash Potential #6 (Risk Category C) – Traffic Control Devices

We noted some instances of improper sign use throughout the study area. There were other instances of improper placement, knock downs, vandalism, and poor maintenance that resulted in signs not being visible at night. Pavement markings were generally the same mixed bag; most were in good shape with some glaring exceptions. Some examples of problems with pavement markings include inconsistent use of sharrows for cyclists, old markings that had not been fully removed in areas where changes have been made, and some markings that have been completely worn away.

Regarding traffic signals, we noted several outdated diagonal span-wire mounted signals that should be considered for modernization. There was also one that lacked the countdown feature for its pedestrian signal heads. But the most common item we identified were the locations where a leading pedestrian interval would improve safety for pedestrians crossing at those signals.

The final item considered in the category of traffic controls involved roadside barriers. We found and noted locations where repairs were needed, as well as an instance that the guardrail did not extend long enough to encompass a fixed object hazard that motorists should be shielded against.

Potential Improvement Projects

The balance of the RSA report identified various alternatives, anywhere from two to four, for specific locations in the study area that were considered particularly problematic, whether from safety or other reasons. These special locations were:

- Pontiac Trail at Moore St / Longshore Dr
- The 'downtown' area encompassing Maiden Ln, Wall St, Swift St, Moore St, and Canal St
- The junction of Broadway St, Division St, Beakes St, Detroit St, High St, Carey St, and Summit St.
- Fuller Rd at Maiden Ln / Medical Center Dr
- Northside STEAM School

The RSA report and the alternatives presented in it can be found in Appendix D and are further discussed later in this report.

D. Pedestrian & Bicycle Existing Condition Audit

The analysis tools used for non-motorized modes were the Pedestrian Environmental Quality Index (PEQI) and Bicycle Environmental Quality Index (BEQI). They are both based on observational field survey to describe the pedestrian and/or bicycle environment with an index score from 0 (extremely poor) to 100 (excellent).

Audit forms developed by the San Francisco Department of Public Health (SFDPH) were used to collect data for pedestrian and bicyclist facilities in the Lower Town area of Ann Arbor. Field data collected is based on street and intersection environmental factors known to affect pedestrian and bicyclist travel behaviors. Data was collected in teams of two to observe both sides of the road. One audit form was used per intersection and street segment. For each of the PEQI and BEQI, data was collected in the following five categories:

- Intersection safety
- Traffic
- Street design
- Land use
- Perceived safety

Each category has a variety of indicators to check for; for example, the PEQI intersection safety category consists of crosswalks, pedestrian signals, curb ramps, and lighting. The survey responses are then converted into numeric values to determine a final score. Numeric values and their relative weightings were based on the default criteria/thresholds identified by the SFDH for both the PEQI and BEQI.

Scores were calculated for each intersection and street segment as defined by the PEQI and BEQI weighting indicators. These scores were then mapped to visually display the score based on the following thresholds:

0 – 20	Unsuitable for pedestrians/bicyclists
21 – 40	Poor pedestrian/bicyclist conditions exist
41 – 60	Basic pedestrian/bicyclist conditions exist
61 – 80	Reasonable pedestrian/bicyclist conditions exist
81 – 100	Ideal pedestrian/bicyclist conditions exist

The PEQI results are illustrated in Figure 6, and the majority of street segments provide basic or reasonable pedestrian conditions with the exception of segments where no pedestrian facility (i.e. sidewalk) is provided. Based on the PEQI scores, six out of the eight signalized intersections within the study area provide reasonable pedestrian conditions. Many of the stop-controlled intersections were rated as poor due to missing curb ramp or crosswalk features.

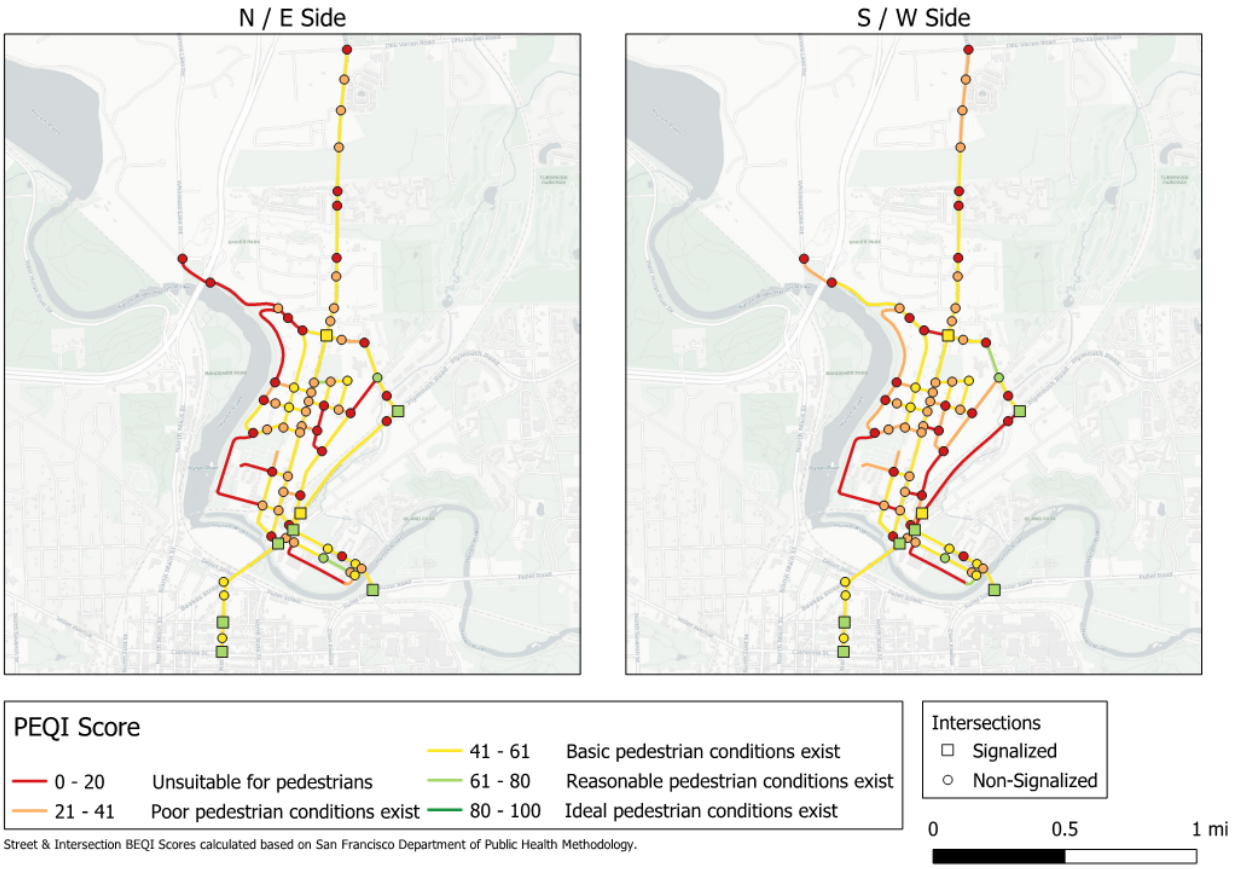


Figure 6: Pedestrian Environmental Quality Index (PEQI)

As shown in the BEQI results in Figure 7, all the street segments provide basic or reasonable bicyclist conditions except for a short segment on Longshore Drive south of Barton Drive. This segment is an unpaved road consisting of horizontal curves obstructing the line of sight. All the intersections, signalized and unsignalized, provide basic bicyclist conditions.

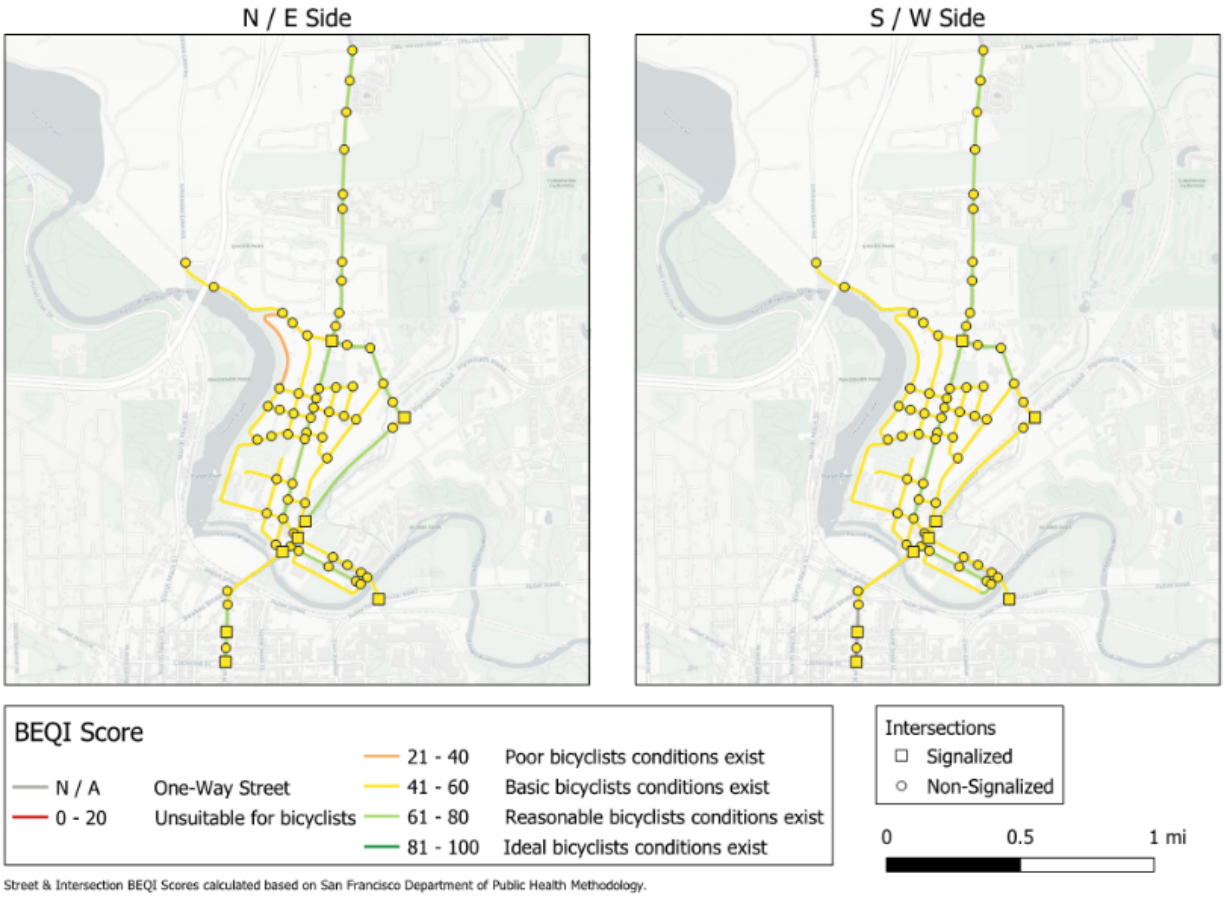


Figure 7: Bicycle Environmental Quality Index (BEQI)

The full report of pedestrian and bicycle facility quality review can be found in Appendix E.

E. Pedestrian Crossing Analysis (NCHRP 562)

One of the requirements of the project was for an evaluation of the uncontrolled crossings within the Study Area in accordance with the National Cooperative Highway Research Program Report (NCHRP) 562. The purpose was to propose recommended pedestrian crossing treatments for existing locations and to identify new locations where such crossings are needed.

The use of NCHRP 562 is intrinsic to the city's process of determining the design standards to be implemented for pedestrian crossings. The City's design guidelines are stratified into three categories: Standard, Standard Plus and High Risk. The choice of various treatments would then be further refined depending on the functional classification and characteristics of the roadways to be crossed. The process and design guidelines are encompassed in a city document called **Ann Arbor Pedestrian Crossing Guidelines Quick Sheets**, dated January 15, 2019.

A spreadsheet was created for this project for implementing NCHRP 562. The new Excel file incorporates not only the logic structure of the NCHRP 562 guidance but also that of Ann Arbor's Pedestrian Crossing Guidelines. The outputs of this new spreadsheet are both one of the four NCHRP 562 treatment categories and the corresponding Ann Arbor set of three design guidelines.

A total of 31 existing pedestrian crossings were evaluated. This number is a fraction of the total pedestrian crossings in the study area. Excluded from the evaluation were those at intersections under traffic signal control, as well as those that represent the crossings of two local streets. Examples of each would be Broadway St at Swift St and Chandler Rd at Indianola Ave, respectively. For the former type locations, the Ann Arbor set of design guidelines do not apply, and for the latter, there is no usage data for vehicle volumes and pedestrians to make for a meaningful analysis.

From the evaluation, we found a variety of locations had deficiencies. The following are locations where high visibility crosswalk markings should be installed:

- Across Barton Dr at Starwick Dr
- Across Pontiac Trail at Montana Way
- Across Pontiac Trail at Polson St
- Across Traver St at Moore St

It should be noted that the intersection of Barton Dr at Starwick Dr is located on a curve and warrants further discussion as to options for placement of the pedestrian crossing. A detailed description is included in the full pedestrian crossing review located in Appendix F. Additionally, there is a discussion on the treatment for the boardwalk opening along Barton Dr between M-14 and Brede Place.

A few other existing locations merited additional changes. We also had evaluated the study area to identify where new pedestrian crossings would be merited. One key consideration was providing convenient crossing locations to be able to access public transit bus stops. Another consideration was the spacing and distance between existing pedestrian crossings as a representation of adverse travel to be able to cross major streets. With these factors in mind, we identified four locations where new pedestrian crossings should be provided. They are:

- Across Pontiac Trail at Skydale Dr
- Across Pontiac Trail at Rudolf Steiner School south driveway
- Across Pontiac Trail at Northside Ave
- Across Swift St north leg at Pontiac Trail

When evaluated, all these locations were judged to merit Standard treatments. In their cases, this means that high visibility crosswalk markings should be installed. The full pedestrian crossing review can be found in Appendix F.

F. Travel Demand Analysis

WSP, in coordination with OHM, the City of Ann Arbor, and the Southeast Michigan Council of Governments (SEMCOG) reviewed the travel demand model (TDM) maintained by SEMCOG to provide a planning level summary of the vehicle origin-destination trends to and from the Lower Town study area for the base year of 2020. The purpose of this review was to answer the following questions:

- Where are trips originating from that are using the transportation network of Lower Town?
- How much of this traffic is destined to Lower Town versus using the network to pass-through Lower Town to another destination?
- Where are trips going that originate in Lower Town?

Additionally, the City of Ann Arbor requested that an example be provided of how the TDM could be used to trace travel patterns in a future year scenario to assist the development of transportation network

improvement strategies at locations identified as “hot spots,” or bottleneck locations within the Lower Town transportation network.

The SEMCOG TDM was used for this analysis. The TDM estimates current and forecast motorized vehicle travel volumes, speed, and patterns in Southeast Michigan. The model looks at demographic and socioeconomic data to generate the anticipated number of trips between origins and destinations and uses household trip surveys and transit rider survey information to calibrate and validate the model. Additionally, the metrics can be summarized for different time periods of the day, including the AM peak, Midday, PM peak, Evening, Night, and Daily.

A series of geographic zones were developed in a process known as districting. This process creates geographic zones by aggregating adjacent traffic analysis zones (TAZs) into larger geographic groupings (districts) that aid in the visualization of the travel patterns between geographic areas of interest. Districts are typically smaller in size close to the primary area of interest (Lower Town) and increase in size further from the study area.

The analysis then tracks and captures all trips either originating in or destined to the Lower Town district and quantifies the distribution between the various districts. The Barton, Main, Plymouth, and Washtenaw Avenue interchanges are the primary access points from the freeway network to Lower Town with the University of Michigan Hospital campus being the major trip producer in Lower Town.

The TDM model indicates that of the traffic specifically traveling to and from Lower Town, approximately 60% are Ann Arbor based and 40% are from outside Ann Arbor.

Table 2 shows that of the current trips using the transportation network in Lower Town, 45% are trips destined to or from Lower Town and 55% of the trips are using the transportation network to pass-through Lower Town to other city destinations. The pass-through trips primarily are traveling through Lower Town to reach downtown Ann Arbor per the TDM estimate.

Table 2: Daily Select Link Analysis Results

Daily Metric	Select Link Analysis				
	To Lower Town from Other Districts	From Lower Town to Other Districts	Lower Town to Lower Town	Pass-Through	Total
Trips	14,247	13,970	2,600	37,454	68,271
% of Trips	21%	20%	4%	55%	**100%**

As indicated earlier, the City of Ann Arbor requested that an example be provided of how the TDM could be used to trace travel patterns in a future year scenario to assist the development of transportation network improvement strategies at locations identified as “hot spots,” or bottleneck locations within the Lower Town transportation network.

The City identified the eastbound Barton Drive approach at the Pontiac Trail intersection during the AM peak period for the theoretical bottleneck location for the example. The analysis performed to trace the traffic origins arriving on the eastbound Barton Drive approach and ultimately where this eastbound approach traffic goes after going through the Pontiac Trail intersection is done via a directional select link analysis.

For this example, results for only the eastbound approach during the AM peak period were summarized Using the 2020 base year TDM. In practice, if there were multiple approaches contributing to the bottleneck or of particular interest, each approach would have a directional select link analysis performed. Also, if evaluating a future year scenario, the 2040 TDM model would be used instead of the 2020 base year, but the same analysis mechanics apply.

It was found that only 24% of the traffic traveling on EB Barton at Pontiac Trail are traveling to the Lower Town district. Most of these trips have destinations outside Lower Town. In fact, of 95% of the pass-through trips are traveling to parts of Ann Arbor other than Lower Town. The remaining 5% of the pass-through trips are passing through the Lower Town district and beyond the limits of Ann Arbor (4% to Washtenaw County and 1% to other SE Michigan destinations). The full travel demand model analysis can be found in Appendix G.

G. Travel Demand Forecasting (2040)

Having utilized the SEMCOG TDM to demonstrate the ability to trace travel patterns, the next logical step was to develop a 2040 horizon year forecast for use in the operational analysis of specific locations in the transportation network. The SEMCOG TDM already is premised on anticipating developments that will result in changes to population and the number of jobs. To verify that all known developments were accounted for, Ann Arbor provided traffic impact studies for ten developments that were seeking approval in the city. These are shown in Table 3.

Table 3 – TIS Development Vehicle Trips

TIS REPORT	AM PEAK VEH. VOL.	PM PEAK VEH. VOL.	WEEKDAY VEH. VOL.	COMMENTS
841 Broadway	86	172	2,079	
1040 Broadway	239	309	3,474	TIS accounts for multi-modal split
Bristol Ridge	23	28	322	
Inpatient Tower	101	66	167	Weekday total = AM + PM peak
Barton Green Cottages	149	212	1,798	TIS accounts for multi-modal split
Nixon Farms	142	139	1,666	1/5 partially built
North Sky	84	108	1,254	1/8 partially built
Village of AA	175	208	2,776	
Wall Street Parking	354	325	679	Observed vehicle trips, multi-modal split not applied. Weekday total = AM + PM peak
Woodbury Club	79	98	1,067	
TOTAL	**1,432**	**1,665**	**15,282**	

A background growth rate was identified that did not account for the ten developments noted above. This turned out to be 6.38 percent over existing 2020 volumes. Once the traffic from the developments were distributed over the Lower Town roadway network, 2040 peak hour volumes were available for use in detailed operational evaluations, as described in the following Sections. A more detailed explanation of the steps taken to arrive at the 2040 forecast is available in Appendix H.

H. Microsimulation (Capacity) Analysis

The software tool Synchro / SimTraffic TM was used to evaluate the major road network in the Lower Town study area. Synchro is a robust, user-friendly traffic application that permits for the analysis, design, modeling, optimization, simulation, and animation of signalized intersections, unsignalized intersections, and roundabouts. The package combines the modeling capabilities of Synchro analysis software, and the microsimulation and animation capabilities of SimTraffic software. The analytical engine complies with the Highway Capacity Manual (HCM) 6th Edition for best practice methodology traffic analysis. In addition to traditional intersection analysis in Synchro, Rodel software was used for any necessary analysis of modern roundabout intersections.

A model was created for the Lower Town area, and we collected and populated the model with the relevant data:

- traffic counts, including pedestrian volumes,
- the number of lanes and geometrics of the key intersections,
- signal timing information, and
- regulatory matters, such as speed limits and turning restrictions.

The resulting simulation model for existing conditions was calibrated and validated by comparing the counted volume to the modeled volume of traffic moving through each intersection. Once completed, the average delay could be determined at the various intersections, be it for individual movements, approaches or for the whole intersection. This allowed for the identification of capacity deficiencies, and the determination of a corresponding level of service (LOS) values for each intersection movement as well as the intersection as a whole.

The LOS of an intersection is based on factors such as number and types of lanes, intersection controls such as STOP signs or traffic signals, traffic volumes, pedestrian volumes, etc. LOS is expressed as a letter grade, in a range from A through F. In this context, 'A' represents the best conditions, with very little or no average delay to vehicles. LOS 'F' is the worst of conditions, equated with very large average delays and few gaps of acceptable length. The following tables identify level of service criteria for signalized and un-signalized intersections.

Table 4: Level of Service Criteria for Signalized Intersections

Level of Service	Average Delay/Vehicle (seconds)	Description
A	Less than or equal to 10	Most vehicles do not stop at all. Most arrive during the green phase. Little or no delay.
B	> 10 to 20	More vehicles stop than for LOS A. Still good progression through lights. Short traffic delays.
C	> 20 to 35	Significant numbers of vehicles stop, although many pass through without stopping.
D	> 35 to 55	Many vehicles stop. Individual signal cycle failures are noticeable. Progression is intermittent.
E	> 55 to 80	Considered to be the limit of acceptable delay. Individual cycle failures are frequent and progression is poor.
F	>80	Extreme and unacceptable traffic delays.

SOURCE: Transportation Research Board, Highway Capacity Manual 2010.

Table 5: Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Delay/Vehicle (seconds)	Description
A	0 to 10	Little or no delay, very low main street traffic
B	> 10 to 15	Short traffic delays, many acceptable gaps
C	> 15 to 25	Average traffic delays, frequent gaps still occur
D	> 25 to 35	Longer traffic delays, limited number of acceptable gaps
E	> 35 to 50	Very long traffic delays, very small number of acceptable gaps
F	>50	Extreme traffic delays, virtually no acceptable gaps in traffic

SOURCE: Transportation Research Board, Highway Capacity Manual 2010.

An intersection LOS 'D' is considered by many traffic safety professionals to be the minimum acceptable condition in an urban/suburban area and this was utilized as the study goal. It was determined that under existing traffic volumes, multiple study intersections had some form of operational deficiency that could be addressed.

Table 6: Existing Conditions Delay and Level of Service at Locations of Concern

	Deficient Movement	Movement AM Peak		Movement PM Peak		Intersection AM Peak		Intersection PM Peak	
		Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS
Barton at Plymouth	EB Left Turn	**85.2**	**F**	**62.8**	**E**	26.2	C	16.1	B
Barton at Pontiac	SB Thru	**42.4**	**D**	14.3	B	33.1	C	20.7	C
Barton at M-14	WB Thru	17.3	C	**59.5**	**F**	**35.4**	**E**	**41.9**	**E**
	SB Left Turn	**54.4**	**F**	17.2	C				
Broadway at Maiden/Moore	NB Left	22.1	C	**68.4**	**E**	24.8	C	31.8	C
	WB Left	**60.1**	**E**	24.7	C				

To resolve these deficiencies, and address identified safety and mobility concerns, several alternatives were modeled using Synchro and Rodel for select intersections in the Lower Town Area. Alternatives were created for the intersections of:

- Barton at Plymouth
- Barton at Pontiac
- Barton at M-14
- Beakes at Broadway
- Broadway at Maiden and Moore
- Pontiac at Moore and Longshore

Alternatives range from adding a turn lane to reconfiguring the intersection. The alternatives are based on the current AM and PM peak conditions. Three signal warrant analyses were also prepared, for M-14 EB off ramp at Barton, Pontiac Trail at Dhu Varren, and for Pontiac Trail at Arrowwood.

The alternatives identified by way of this analysis are discussed in a later section of this report, ***Study Alternatives.*** Also, the full microsimulation analysis for existing conditions can be found in Appendix I.

I. Public Engagement

As is typical for large-scale transportation planning studies, the project included a substantial public engagement component. However, this portion of the work was significantly complicated when the COVID-19 pandemic curtailed the ability to elicit in-person participation from the residents of Ann Arbor. So, while some of the initial outreach did involve face to face interactions, the project team needed to adapt and rely on other outreach methods that conformed to the social distancing requirements to deal with the pandemic.

Stakeholder Meetings

As initially conceived, the public involvement would focus on a series of interviews with stakeholders, then transition to four public meetings. The stakeholder meetings were held in-person in December 2019, prior to the onset of the pandemic. The OHM team scheduled interviews with 10 different stakeholder groups. The groups were chosen by staff from the City of Ann Arbor and the consultant team to ensure that a broad and diverse representation of all viewpoints was achieved. The stakeholder groups and individuals shown in Table 7 below were interviewed for the Lower Town Study.

The 12 businesses and 10 neighborhood associations located in the Lower Town neighborhood were all invited. However, no representatives from the neighborhood business stakeholder group were able to join. To capture as much input as possible from the stakeholders, the project team developed a four-question online survey to send to those who were unable to join the interviews. The survey consisted of the same questions asked in the interviews.

Table 7: Lower Town Stakeholder Groups

Stakeholder Group	Date of Interview	Attendees
Ann Arbor City Council	12/2/19	Jeff Hayner
University of Michigan	12/2/19	Sue Gott
		Sven Sawin
		Steve Dolen
Ann Arbor Public Schools	12/2/19	Liz Margolis
		Tina Carmichael
		Meg Fenech
		Carlene Colvin-Garcia
Transit and Commuting	12/5/19	Chris Simmons
		Ken Anderson
Regional Agencies (MDOT & WATS)	12/5/19	Kari Martin
		Laurent Fournier
		Ryan Buck
Neighborhood Groups	12/16/19	Laura Stowe
		Tom Stalberg
People with Disabilities	12/16/19	Alex Gossage
Lower Town Businesses	12/17/19	N/A
City of Ann Arbor	12/17/19	Molly Maciejewski
		Kathleen Summergill
		Hillary Hanzel
		Brett Lenart
		Luke Liu

Walking and Biking Advocacy	12/18/19	Nate Phipps
		Valarie Shinaberger
		Larry Deck

After meeting with and talking to the diverse group of stakeholders representing the Lower Town Neighborhood, the project team was able to identify some common themes related to mobility in the area. Many of the same issues were raised by each group but opinions varied on how to fix the problems. The issues raised involved:

- Traffic volumes and speed
- Traffic safety
- Impacts from new development
- Commuting
- Bicycle and pedestrian connectivity
- School safety for Northside STEAM
- Public transit

It was agreed by various stakeholder participants that there were opportunities available for Lower Town. The ideas advanced involved:

- Improved public transit
- Enhanced pedestrian connection to the U of M Hospital
- Providing non-motorized connections
- Maximizing comfort for bicyclists and pedestrians
- Focusing on transit-oriented mixed-use development

Public Meeting #1 – July 29, 2020

The first public meeting was held after the social distancing requirements due to the COVID-19 pandemic was in effect. The meeting was held by way of video conferencing. The meeting was recorded, and the video and audio was made available on the City's project website.

The meeting began with a presentation to introduce the project to the public. There were several project tasks that had already been undertaken and were either in progress or had been completed. These activities were summarized to the attendees. These tasks included:

- Engagement of stakeholder groups
- Policy documents review
- Data collection
- Crash analysis
- Road safety audit
- Analysis software selection process – not yet completed
- Evaluation of existing conditions – not yet completed

We also noted what the next steps were. After the presentation was completed, there was an opportunity for questions from the attendees. A summary of all the questions asked and corresponding answers was compiled and is provided in Appendix J, as well as a copy of the presentation. This appendix is also where all subsequent public meeting presentations and notes are to be found.

The initial public meeting had sparse attendance. Due to this, the City and OHM team opted to offer additional opportunities for the public to learn about the project. Toward this end, it was decided to offer

a series of four 'virtual office hour' meetings. The concept was for several limited recaps of the presentation offered for the first public meeting. Each office hour was a video presentation on a single, focused aspect of the project. The date and topics of the meetings were:

- 9/25/2020 What is this Mobility Study?
- 10/9/2020 Traffic Conditions: What Contributes to Traffic Congestion?
- 10/23/2020 Bicycle and Pedestrian Conditions: How Can We Make Walking and Biking Easier?
- 11/6/2020 Safety Conditions: How Can We Make Traveling Safer?

After each short form presentation, there were several questions posed by the OHM team to help spark discussion. As with the initial public meeting, the questions and answers were compiled and are provided in the Appendix.

Public Meeting #2 – November 19, 2020

The goals of the second public meeting were to report on the findings from the existing conditions evaluation, discuss the vision and goals for the Lower Town area, and begin the process of brainstorming alternatives. Unfortunately, there were only two attendees for this public meeting. Regardless, the presentation went over the issues, concerns, and opportunities we had heard from the stakeholders, and attendees from the first public meeting and subsequent video office hours.

The findings from the existing condition evaluations included going over locations identified with congestion by either observation, or the simulation models created of the area, the origin and destination patterns learned from the travel demand modeling, the pedestrian and bicycle facilities conditions, and a review of key uncontrolled pedestrian crossings.

Despite the paucity of attendees, an open discussion was had with the attendees around the issues, opportunities, and goals for mobility in the Lower Town Area. As with the previous meetings, the questions and answers were compiled and are provided in the Appendix.

Public Meeting #3 – June 6, 2021

The third public meeting was to report out the solutions and alternatives identified to date. Many of the changes being suggested were the result of various project efforts, like outreach to stakeholders and the public, the crash study, the Road Safety Audit, and brainstorming sessions held with the study team and city staff. The goal of the meeting was to gather further public input on possible actions to be taken.

Again, this public meeting had sparse attendance. So again, the City and OHM team opted to offer additional 'virtual office hour' opportunities for the public to provide input regarding possible improvements. Each provided limited recaps of the proposed improvements by mode and then focused on whichever modes or locations the participants wished to discuss. The date and key topics discussed at each of the meetings are listed below, additional information on these meetings is provided in Appendix J.

- 7/23/2021 Pedestrian and Bike Issues
- 8/6/2021 Moore / Pontiac / Longshore Alternatives
- 8/20/2021 Broadway / Beakes / Division Alternatives
- 9/3/2021 Speed Management and Potential Moore St Conversion to 2-way

Public Meeting #4 – September 23, 2021

The fourth and last public meeting was to report out the recommendations of the project team, including which alternatives were being proposed for implementation. Changes because of previous public comment were included in the recommendations. Other recommendations were the result of various project efforts, like the crash study, the Road Safety Audit, and other project sessions held with the study team and city staff. As with the previous public engagement meetings, the event was held by way of video conferencing and the session was recorded. The recordings are all available on the project web page on the City's web site. A copy of the presentation and meeting notes are found in Appendix J.

III. STUDY ALTERNATIVES

The Road Safety Audit (RSA) conducted by the OHM Advisors team noted a small number of intersection locations where the fundamental intersection geometry was believed to be a contributing factor to the number and /or severity of the crashes they experienced. This report seeks to amplify the discussion on the alternatives, the basis for suggesting them and their relative benefits and drawbacks.

A. Beakes St / Broadway St / Division St

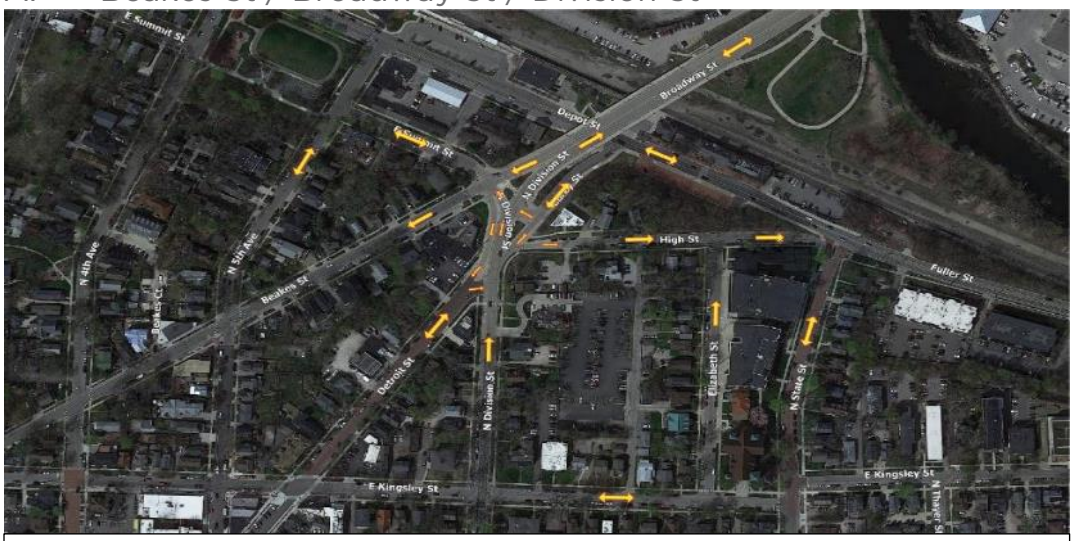


Figure 8 – Overview of the area just north of Kerrytown, showing pattern of one-way and two-way streets.

Existing Characteristics

The one-way pair of Division St (NB) and Beakes St (SB) join for 2-way movements at Broadway St. In addition, there are further junctions with Summit St (2-way movements), Detroit St (2-way including a special one-way connection opposite Summit St), Carey St (2-way), and High St (1-way). Summit, Carey, and High provide access to and from Depot St.

The existing configuration involves 42 conflict points, of which 22 involve pedestrian crossings. Of the remaining 20, five are of vehicle paths crossing each other, seven where vehicle paths join or merge together and eight where they diverge. This large number of conflicts logically relates to the relatively high number of crashes that occurs in this area annually.

Existing Configuration Pro

Residents, whether as drivers or as active transportation users (bicyclists and pedestrians), are already familiar with this junction of seven streets, including the unique way the 1-way streets fit into the puzzle. Traffic along the south side of the river / RR tracks have relatively simple and short connections to achieve the Broadway St bridge into Lower Town. There are no gaps in the sidewalk system and the existing pedestrian crossings of Beakes and Division are reasonable approximations of the desire lines for their movement.

Existing Configuration Con

This is a confusing junction for motorists not previously familiar with area. From a human factors viewpoint, the roadway geometry and density of connections results in an abnormally high information

workload for motorists. Further, the geometry is biased for generally promoting relatively high-speed movements for Division / Beakes / Broadway traffic. The movement of NB Division turning to NB Carey is also considered a high-speed movement, as it looks more like a highway ramp than a street intersection. The northmost location of the pedestrian crossing of Division reflects poor sight distance, enhancing the risk of pedestrians using this crossing. Contributing to the crashes is the lack of turn storage for NB Division turning onto Summit (or Beakes). Queuing for these movements exceed the storage available and impeded the Division to Broadway movements, as reflected in the high number of rear-end collisions.

Basis for Developing Alternate Layouts

Using conflict points as a surrogate for crash risks, the fundamental goals was to identify options that would reduce the number of conflicts. Where possible, conflicts of pedestrians crossing vehicle paths and vehicles crossing other vehicle paths were a priority for reduction. However, maintaining a high level of pedestrian mobility meant that a truly significant reduction in pedestrian crossings was not likely. So, the options needed to consider reducing motorists' information workloads in conjunction with better traffic control device protections at the at-risk crossings.

Option A Characteristics

This option eliminates the movements to and from Summit and extends the on-street parking along the west side of Division to just short of Detroit. It has 23 conflict points, 45% fewer that existing conditions. They include 15 with pedestrians, one with vehicles crossing paths, three merging and four diverging vehicle paths. With this option, the City may wish to consider installing Rectangular Rapid Flash Beacons (RRFB) or Pedestrian Hybrid Beacons (PHB) for one or more of the crossings of Beakes and Division. Movements that are eliminated in this option are:

- NB Division to WB Summit / SWB Beakes
    - Potential detour: NB Carey to WB Depot to SB 5th
- EB Summit / SB Broadway to Detroit
    - Potential detour: Summit or Broadway to SWB Beakes to SB 5th to EB Kingsley

Figure 9: Option A – Close access between Detroit / Division and Beakes / Broadway / Summit.

Option A Pro

This option should generally reduce the number of crashes. Elimination of the two movements to and from Summit and extending the on-street parking along the west side of Division to just short of Detroit increases usable roadway space that can be used to extend the on-street bike lane on NB Division to just short of the Broadway bridge. If desired, a ramp can take the non-confident cyclists off the road and onto the sidewalk along the bridge; whereas adept cyclists would 'Share the Road' with motorist across the bridge. In conjunction with all this, the curve radius for NB Division could be reduced (tightened), a form of geometric speed control. The balance of the space can be landscaped. It is possible for the northmost ped crosswalk across Division to be moved south along Division to improve visibility around the retaining walls in the area. Potential detours are generally short and can be handled by wayfinding signage.

Option A Con

This option eliminates some of the current direct access, relying on alternate routes to achieve parity with existing conditions. Carrying the on-street bike lane past the intersection of Division and NB Carey is problematic, as turning traffic to Carey could take this corner at a relatively high speed, posing a significant conflict point.

Option B Characteristics

Like the first option, this one eliminates the movements to and from Summit and extends the on-street parking along the west side of Division to just short of Detroit. It additionally eliminates the SB Carey intersection with NB Division. This option has 20 conflict points, 52% fewer than existing conditions. They include 13 with pedestrians, one with vehicles crossing paths, two merging and four diverging vehicle paths. With this option, the City may wish to consider installing RRFB or PHB signals for one or more of the crossings of Beakes and Division. Movements that are eliminated are:

- NB Division to WB Summit / SWB Beakes
    - Potential detour: NB Carey to WB Depot to SB 5th to Summit
- EB Summit / SB Broadway to Detroit
    - Potential detour: Summit or Broadway to SWB Beakes to SB 5th to EB Kingsley to Detroit
- SB Carey to Division
    - Potential detour: EB on Depot to SB State to WB Kingsley to Division
    - 2nd Potential detour: WB on Depot to SB 5th to EB Kingsley to Division

Option B Pro

This option has the fewest number of conflict points; so, it should reduce the risk of collisions the most. Elimination of the movements to and from Summit and extending the on-street parking along the west side of Division to just short of Detroit increases usable roadway space that can be used to extend the on-street bike lane on NB Division to just short of the Broadway bridge. If desired, a ramp can take the non-confident cyclists off the road and onto the sidewalk along the bridge; adept cyclists would 'Share the Road' with motorist across the bridge. In conjunction with all this, the curve radius for NB Division could be reduced, a form of geometric speed control. The balance of the space can be landscaped. It is possible for the northmost ped crosswalk across Division to be moved south along Division to improve visibility around the retaining wall. Potential detours for Division to Summit and Summit to Detroit are generally short and can be handled by wayfinding signage.

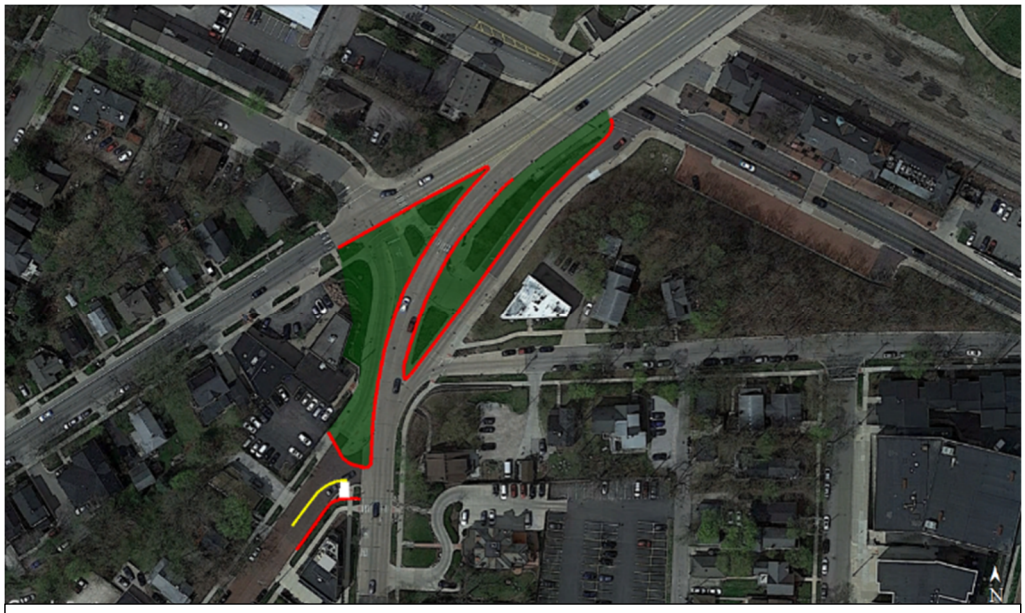


Figure 10: Option B – Variation on Option A. Maintains access from Division St down to Depot St and to High St via Carey, but Depot St up to Broadway St. will be detoured.

Option B Con

This option eliminates some direct access, relying on alternate routes to achieve parity with existing conditions. The detours for Carey to Division are not quite as intuitive. Carrying the on-street bike lane past the intersection of Division and NB Carey is problematic, as turning traffic could take this corner at a relatively high speed, posing a significant conflict point.

Option C Characteristics

This option eliminates the movements from Summit to Detroit, and the movement from Division to Carey but keeps the movement from Division to Summit. Like the previous two options, it extends the on-street parking along the west side of Division to just short of Detroit. This option has 28 conflict points, 33% fewer than existing conditions. They include 16 with pedestrians, two with vehicles crossing paths, five merging and five diverging vehicle paths. With this option, the City may wish to consider installing RRFB or PHB signals for one or more of the crossings of Beakes. Movements that are eliminated are:

- EB Summit / SB Broadway to Detroit
    - Potential detour: Summit or Broadway to SWB Beakes to SB 5th to EB Kingsley to Detroit
- NB Carey to Depot
    - Potential detour: EB on High to NB State to Depot
    - 2nd Potential detour: NB on Division to WB Summit to NB 5th to Depot

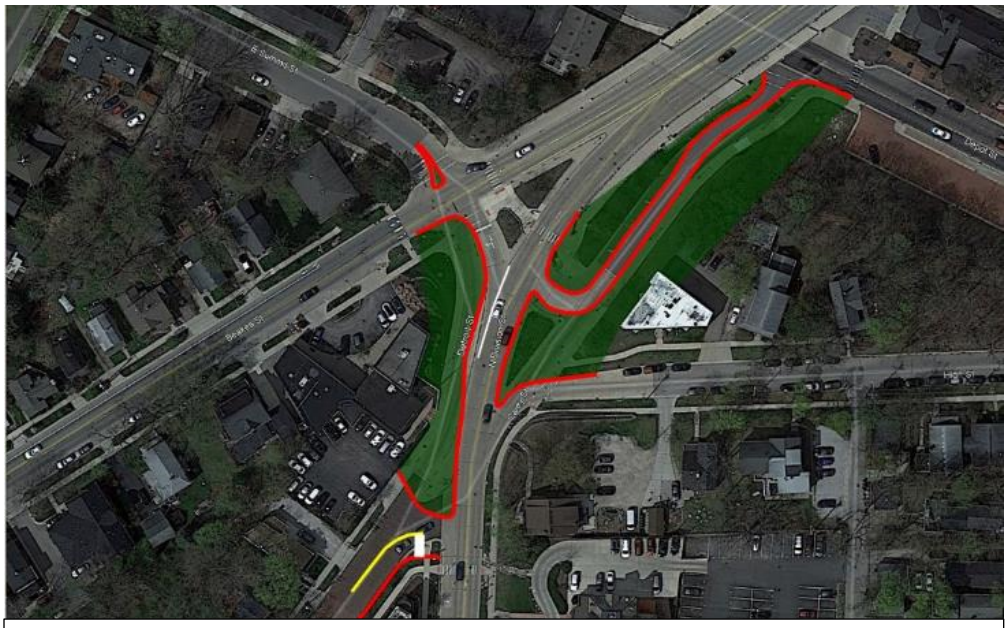


Figure 11: Option C – Close northbound entrance to Carey St from Division St and southbound access to Detroit St from Broadway St/Summit St. Maintains access from Division to Summit. Would maintain access to the Broadway Street bridge from Depot Street and to High Street from Division.

Option C Pro

This option should generally reduce number of crashes. This option has the least disruption to existing travel patterns, but because of the relative number of conflict points will only somewhat reduce the risk of collisions. Potential detours for Division to Carey and Summit to Detroit are generally short and can be handled by wayfinding signage. Elimination of the Summit to Detroit movement and extending the on-street parking along the west side of Division to just short of Detroit increases usable roadway space that can be used to extend the on-street bike lane on NB Division to just short of the Broadway bridge. If desired, a ramp can take the non-confident cyclists off the road and onto the sidewalk along the bridge; adept cyclists would 'Share the Road' with motorist across the bridge. In conjunction with all this, the curve radius for NB Division could be reduced, though not as much as in Options A & B. But is still a form of geometric speed control. The balance of space can be landscaped. It is possible for the northmost ped crosswalk across Division to be moved south along Division to improve visibility around the retaining wall. This option gets rid of the problematic geometry regarding Division to Carey, where turning traffic can currently take this corner at a relatively high speed.

Option C Con

Eliminates some direct access, relying on alternate routes to achieve parity with existing conditions. Vehicles would now be required to reduce speed in the NB Division through lanes when making turns onto High St and Carey St, which could result in rear end crashes.

Option D Characteristics

Operationally, this option is similar to Option A, while correcting the issue of the high-speed turning moment from NB Division to NB Carey. This option has 23 conflict points, 45% fewer than existing conditions. They include 15 with pedestrians, one with vehicles crossing paths, three merging and four

diverging vehicle paths. With this option, the City may wish to consider installing RRFB or PHB signals for one or more of the crossings of Beakes and Division. Movements that are eliminated are:

- NB Division to WB Summit / SWB Beakes
    - Potential detour: NB Carey to WB Depot to SB 5th to Summit
- EB Summit / SB Broadway to Detroit
    - Potential detour: Summit or Broadway to SWB Beakes to SB 5th to EB Kingsley to Detroit

Figure 12: Option D: Variation on Option C. Maintains 2-way movements for Carey, eliminates Summit to Detroit and Division to Summit movements.

Option D Pro

This option should generally reduce number of crashes. The elimination of the movements to and from Summit and extending the on-street parking along the west side of Division to just short of Detroit increases usable roadway space that can be used to extend the on-street bike lane on NB Division to just short of the Broadway bridge. If desired, a ramp can take the non-confident cyclists off the road and onto the sidewalk along the bridge; adept cyclists would 'Share the Road' with motorist across the bridge. In conjunction with all this, the curve radius for NB Division could be reduced, a form of geometric speed control. The balance of the space can be landscaped. It is possible for the northmost ped crosswalk across Division to be moved south along Division to improve visibility around the retaining wall. Potential detours for Division to Summit and Summit to Detroit are generally short and can be handled by wayfinding signage. This option would get rid of the problematic geometry regarding Division to Carey or High St, eliminating the potential for turning traffic to take this corner at a relatively high speed.

Option D Con

This option eliminates some direct access, relying on alternate routes to achieve parity with existing conditions. Vehicles would now be required to reduce speed in the NB Division through lanes when making turns onto High St and Carey St, which could result in rear end crashes.

Option E Characteristics

All the previous alternatives require significant reconstruction to achieve the fundamental goal of reducing crashes. However, the City also sought an option that would be relatively easy to implement and focused on just improvements to pedestrian and bicycle movements. This option would use the existing geometry and pavement, reallocating it to different uses. Rather than terminating the parking

lane on the west side of Division and bicycle lane on the east in favor of three vehicle travel lanes, this alternative carries the parking lane and bicycle lane up to Detroit St. At Detroit, the parking lane would terminate. The bicycle lane would continue up to the north intersection with Carey by utilizing the sidewalk along the western edge of the landscaping triangle that separates the two intersections of Carey. A ramp would be provided for the NB bikes to access the sidewalk across the Broadway bridges. Another bike ramp would allow access to the start of the bicycle lane for Beakes St. There is the possibility to either provide an additional ped crossing or relocating one to a more visible location, using RRFB or PHB for traffic controls.

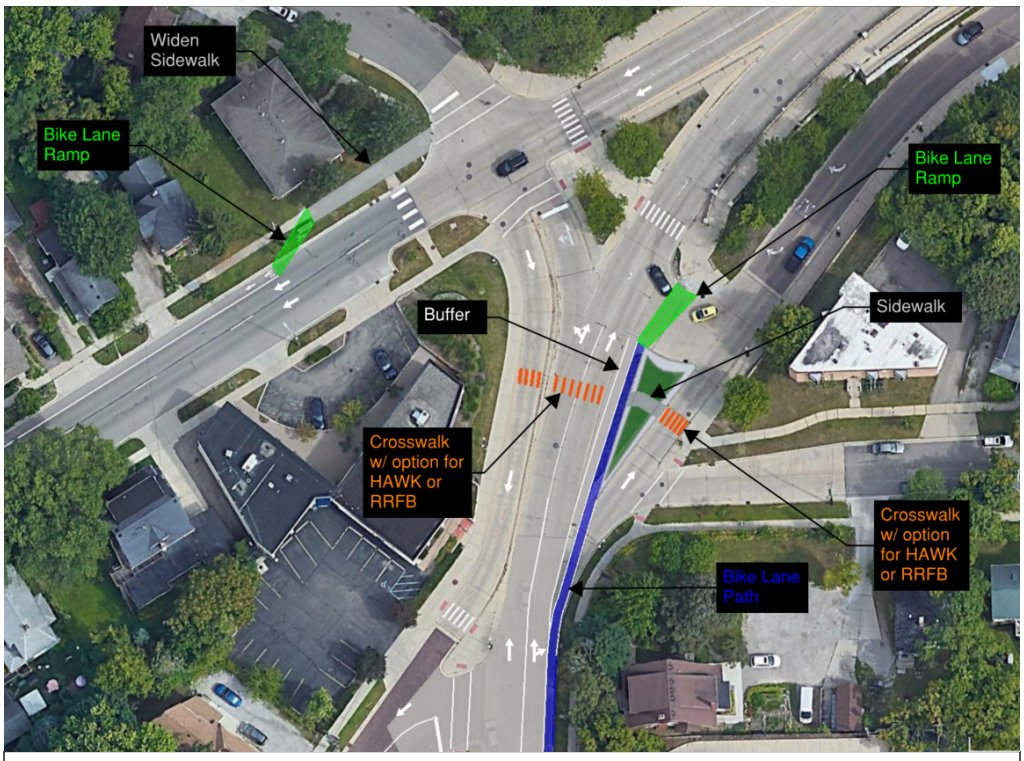


Figure 13: Option E: Short term improvements for bicycle and pedestrian movements. No changes to vehicle conflicts.

Option E Pro

This option will provide continuity for NB Division cyclists having the on-street bike lane connect with the Broadway St bridges side paths. This will connect the SW Broadway bridges side path to the start of the bicycle lane for Beakes St. It provides a new or relocated pedestrian crossing in a more visible location and one that would have the enhanced traffic controls of either RRFB or PHB.

Option E Con

This option does nothing to alleviate the confusing geometry and intrinsically large number of vehicle-vehicle conflicts that contribute to this being a high crash location within Lower Town.

Operational Analysis

All of these options would work well in the Lower Town models. However, with each of the long-term options requiring traffic to shift to other areas of the city, further study would be needed in the surrounding areas to determine if there would be adverse impacts outside of the Lower Town Area.

OHM Recommendation

Each of the alternatives represents compromises in terms of cost, improving safety, restricting movements and the resultant changes to travel patterns. With all this considered, OHM recommends that the City take steps to immediately implement Option E as a short-term measure. In implementing Option E, it is also recommended to include RRFB's for each of the major pedestrian crossings. We recommend using the RRFB over PHB for a couple of reasons: 1) RRFBs are less disruptive to traffic. When RRFBs are actuated, the vehicular traffic yields to pedestrians and can resume moving once the pedestrians are cleared, where with a PHB traffic must first slow and then remain stopped through the signal cycle. 2) Providing incremental improvements will be less impactful to traffic flow in the area and less costly for the City to implement. After installing RRFBs, there is the option to take them to the next level with a PHB if the RRFBs are not providing the intended mobility improvement. It should be noted that OHM has not completed an analysis for RRFB vs PHB for these intersections and a study of pedestrian volumes and crossing demands is recommended.

We also endorse Option D as the long-term solution that represents the best balance between the competing interests. We recommend that an opinion of probable cost be developed for Option D for inclusion in the City's Capital Improvement Plan.

B. Longshore Dr/ Moore St / Pontiac Trail

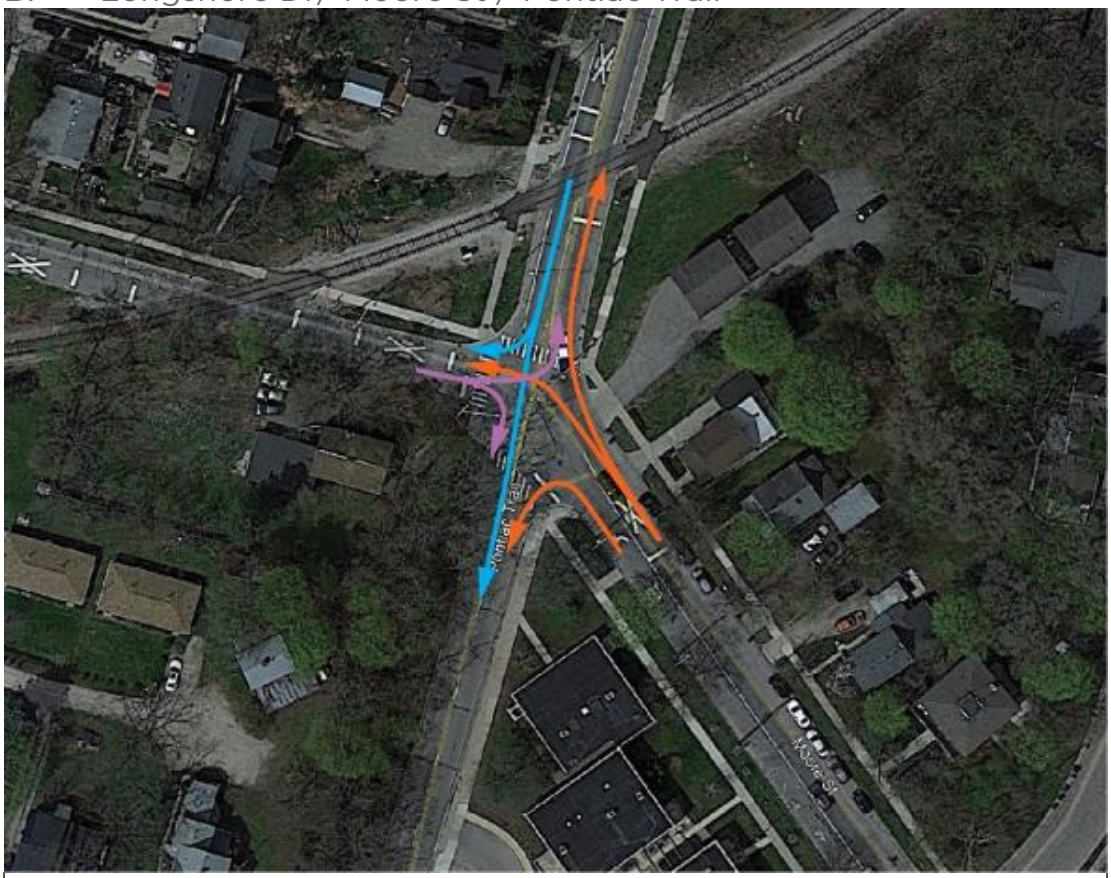


Figure 14: Overview of the area. The south and east legs of intersection are one-way streets. Various allowed movements are depicted.

Existing Characteristics

Moore St and Pontiac Trail / Swift St form a one-way pair that join for 2-way movements on Pontiac Trail northeast of their intersection with Longshore Dr. The existing configuration has 22 conflict points, of which 11 involve pedestrian crossings, three are vehicle crossing paths, four are merging and four are diverging movements.

Existing Configuration Pro

The primary movements by vehicle volumes are NW Moore turning right onto NB Pontiac Trail and SB Pontiac Trail continuing south through the intersection; namely traffic related to the one-way pair. The other turning movements are relatively minor. The traffic controls reflect this primacy of movements.

Existing Configuration Con

The current configuration allows the major movements to operate as free flow. However, the angle Moore joins the intersection results in NW Moore right turning vehicles taking the corner far faster than prudent to limit risks to pedestrians crossing the north leg of the intersection. It is also confusing to drivers that the right turns are free flow while the hard left turns to SB Pontiac Trail and mild left turns to Longshore are under STOP controls. While there are overhead beacons to help with this differential, some may not pick up on the differences of the flashing yellow for the right turns and the flashing red for the left turns.

Basis for Developing Alternate Layouts

Options were identified to reduce not just the number of conflict points but improve the geometry to be more self-evident to drivers what controls were related to each of the movements. Fundamentally, the options look to improve pedestrian safety for their crossings of the intersection legs.

Short Term Option 1 Characteristics

This option is just intended to be a short term measure until decisions are made for a longer-term improvement. It does not change any movements, and thus the number and types of conflict points and consequently the risk of crashes remains unchanged. Other than providing long lasting pavement markings, the only substantial change is to replace the flashing yellow circular beacon light with a flashing yellow right turn arrow for the NW Moore turn to NB Pontiac Trail.

Short Term Option 1 Pro

This option represents a minimal cost solution easily handled withing the City's maintenance budget, to upgrade the traffic controls (markings and flashing beacon). This is to better delineate the vehicle paths through the intersection.

Short Term Option 1 Con

This option does not address the fundamental shortcomings of the geometry of the intersection, nor the high speeds confronting pedestrians crossing the north leg of Pontiac Trail.

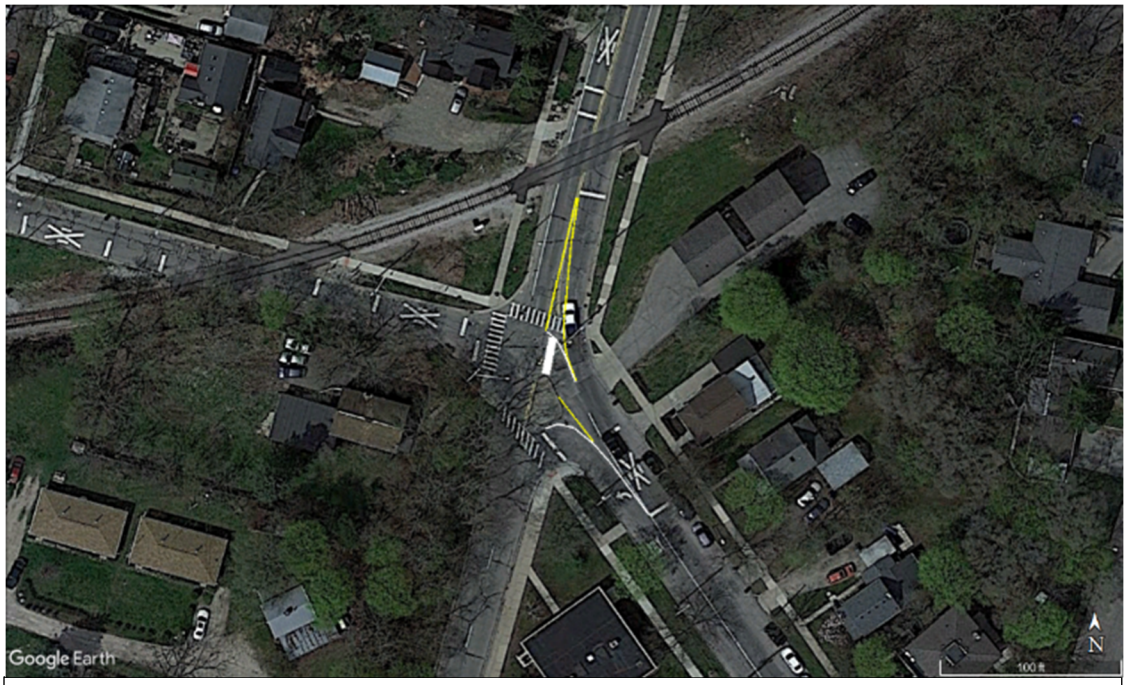


Figure 15: Short Term Option 1: Add pavement markings to better delineate vehicle paths through intersection. Maintain existing signals, but swap flashing yellow circular light for flashing yellow right arrow.

Short Term Option 2 Characteristics

As with the previous one, this option is just intended to be a short term measure until decisions are made for a longer-term improvement. While all the same movements are allowed, it removes the dedicated lane for NW Moore to NB Pontiac. Thus, the number and types of conflict points and consequently the risk of crashes remains unchanged. This option also removes the overhead flasher.

Short Term Option 2 Pro

This is a minimal cost option that is more easily handled within the City's maintenance budget. It allows for the provision of an on-street bike lane on Moore and links it to the existing one on Pontiac. This option better delineates the vehicle paths through the intersection.

Short Term Option 2 Con

This option does not address the fundamental shortcomings of the geometry of the intersection.

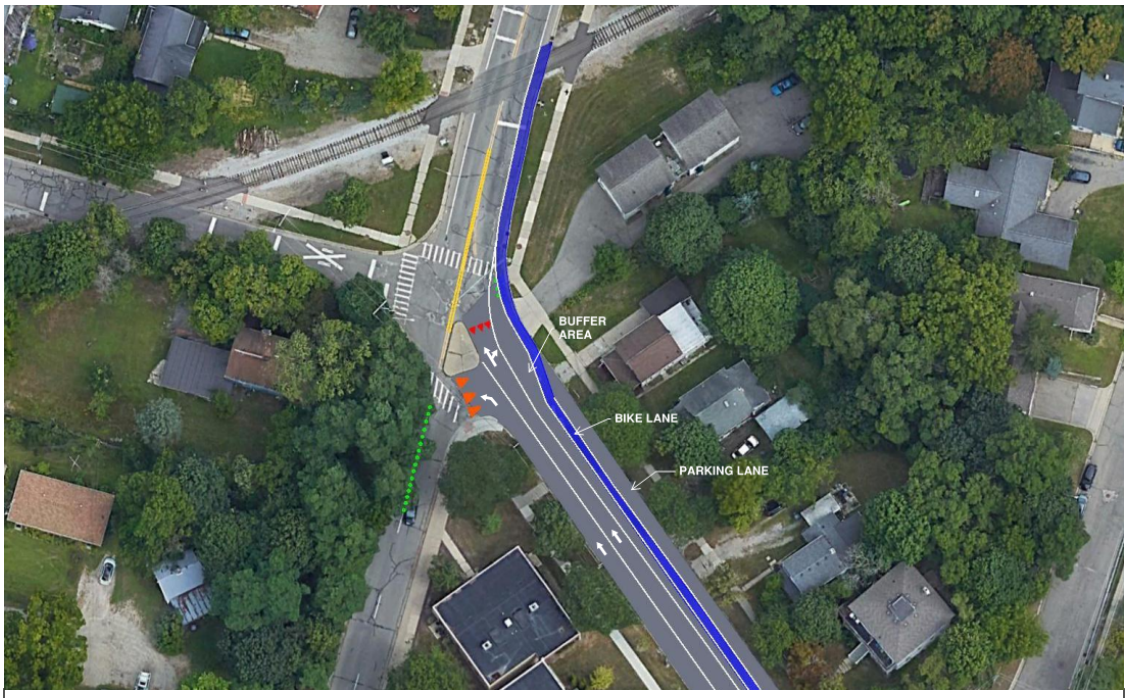


Figure 16: Short Term Option 2: Restripe Moore St to narrow travel lanes to +11' to add a bicycle lane adjacent to the parking lane (northeast curb). Carry the new bike lane onto NB Pontiac Trail, joining existing north of RR tracks. Change intersection control for Moore at Pontiac to YIELD.

Option A Characteristics

This option eliminates one movement, the EB Longshore Dr left turn to Pontiac Trail. It then adds improved channelizing islands to better define the vehicle paths through the intersection. It has 16 conflict points, 27% fewer that existing conditions. They include nine with pedestrians, one with vehicles crossing paths, three merging and three diverging vehicle paths. With this option, the City may wish to consider installing RRFB pedestrian lights for the north leg crossing of Pontiac Trail. Movements that are eliminated in this option are:

- EB Longshore Dr to NB Pontiac Trail
    - Potential detour: NB Wright St to EB Kellogg St to Pontiac Trail

Option A Pro

With the elimination of one turning movement, it will be possible to clear up some of the vehicle paths, reducing driver confusion. Rather than a single non-standard left-hand placement stop sign for the Moore to Longshore movement, a right-hand stop sign can also be provided.

Option A Con

This option eliminates one of the current direct movements, relying on an alternate route to achieve parity with existing conditions. Establishing an on-street bike lane for NW Moore and carrying it past the intersection onto NB Pontiac Trail is problematic, as turning traffic to Pontiac Trail would use this extra pavement to take this corner at a relatively high speed, posing significant conflicts.

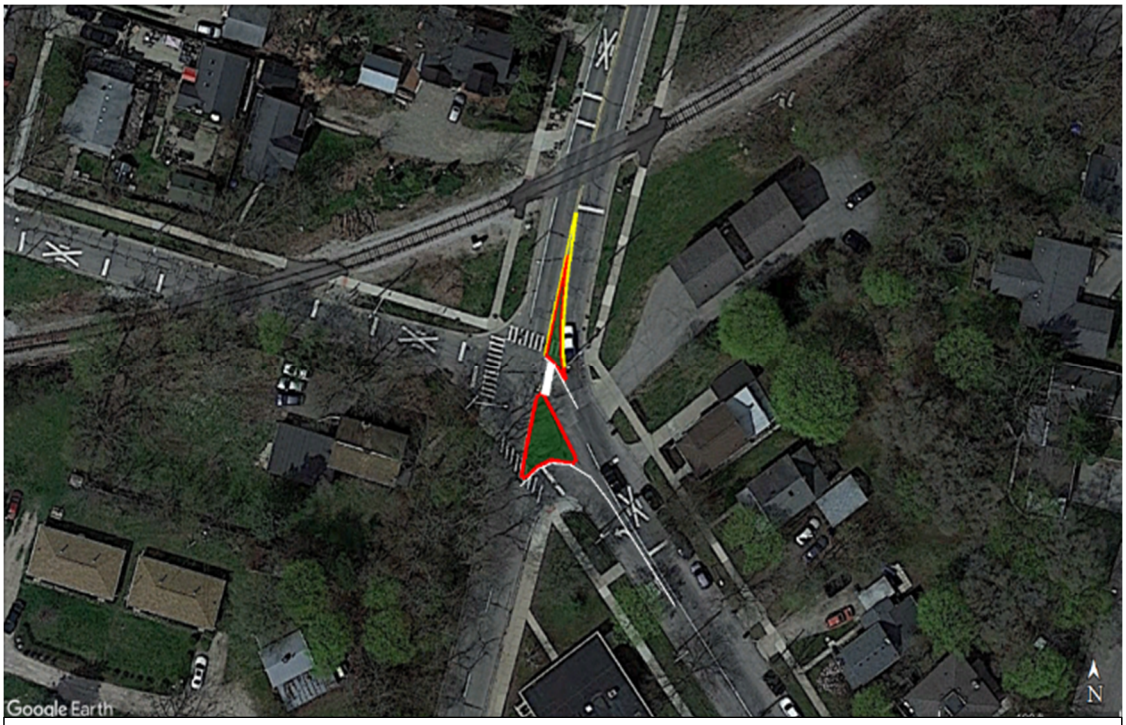


Figure 17: Option A – Add new islands to intersection. An added stop sign would be provided for the Moore Street to Longshore Drive movement. The overhead beacons would be removed in favor of adding RRFB's for the Pontiac Trail pedestrian crossing.

Option B Characteristics

This option eliminates two movements, the EB Longshore left turn to Pontiac Trail and NW Moore left turn to Longshore. This will require a large channelizing island to restrict the vehicle paths through the intersection. It has 12 conflict points, 45% fewer than existing conditions. They include 8 with pedestrians, two merging and two diverging vehicle paths. With this option, the City may wish to consider installing RRFB pedestrian lights for the north leg crossing of Pontiac Trail. Movements that are eliminated in this option are:

- EB Longshore to NB Pontiac Trail
  - Potential detour: NB Wright St to EB Kellogg St to Pontiac Trail
- NW Moore to WB Longshore
  - Potential detour: NB Pontiac Trail to WB Kellogg St to SB Wright St to Longshore St

Option B Pro

With the elimination of the movements between Moore and Longshore it will be possible to greatly clean up the vehicle paths, reducing driver confusion. It may be possible to use the extra space to tighten up the right turn from Moore to Pontiac Trail, slowing the fast path for this movement to the benefit of pedestrians crossing Pontiac Trail. There may be room to add an on-street bike lane starting at the end of on-street parking on Moore and carrying it around the corner to Pontiac Trail and on up to the existing bike lane north of the RR crossing.

Option B Con

This option eliminates two of the current direct movements, relying on alternate routes to achieve parity with existing conditions. While the option has the potential to reduce the concern, it will not eliminate

the issue of turning traffic from Moore to Pontiac Trail taking this corner at a relatively high speed, posing significant conflicts with pedestrians.

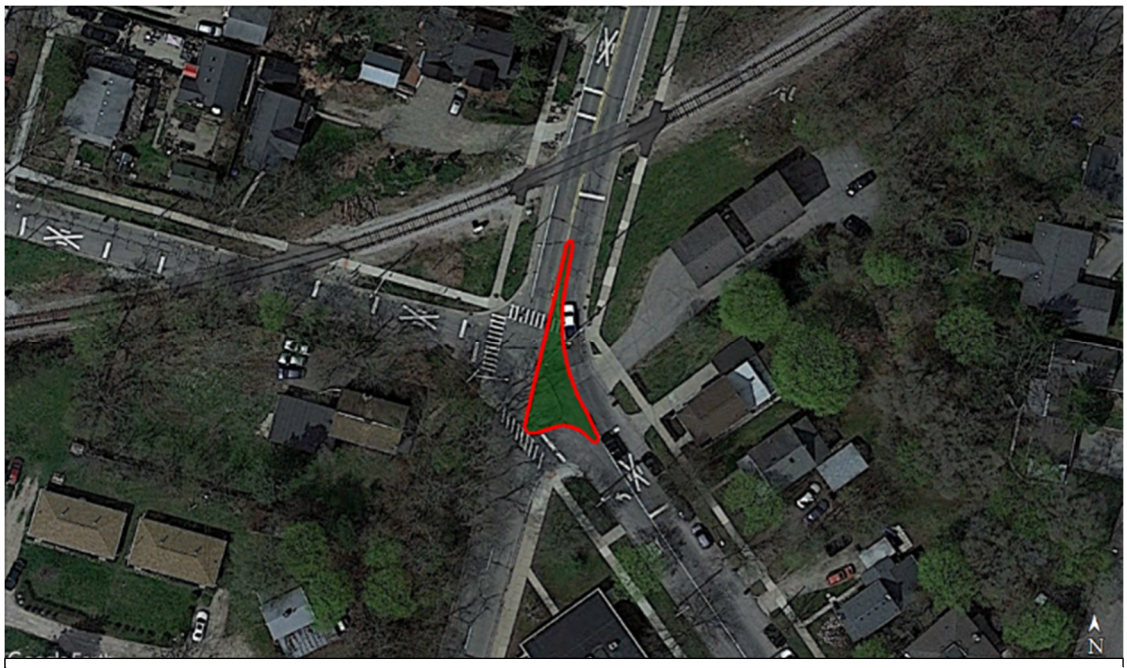


Figure 18: Option B – Add new island to intersection. Treatment would simplify the intersection by allowing only two movements from Moore Street and require Longshore to be right in/out only. Would remove intersection beacons.

Option C Characteristics

This option configures the intersection as an urban compact one lane roundabout. It has 12 conflict points, 45% fewer than existing conditions. They include 6 with pedestrians, three merging and three diverging vehicle paths.

Option C Pro

All current vehicle movements are facilitated with this option. The roundabout would provide the best anticipated safety performance. With this option, all pedestrian crossings would benefit from the splitter islands being refuges for pedestrians crossing the approaches. This configuration allows for a pedestrian crossing of Moore St where one is not currently provided.

Option C Con

This option may need a small amount of road right of way to accommodate the roundabout and the pedestrian sidewalks around the intersection.

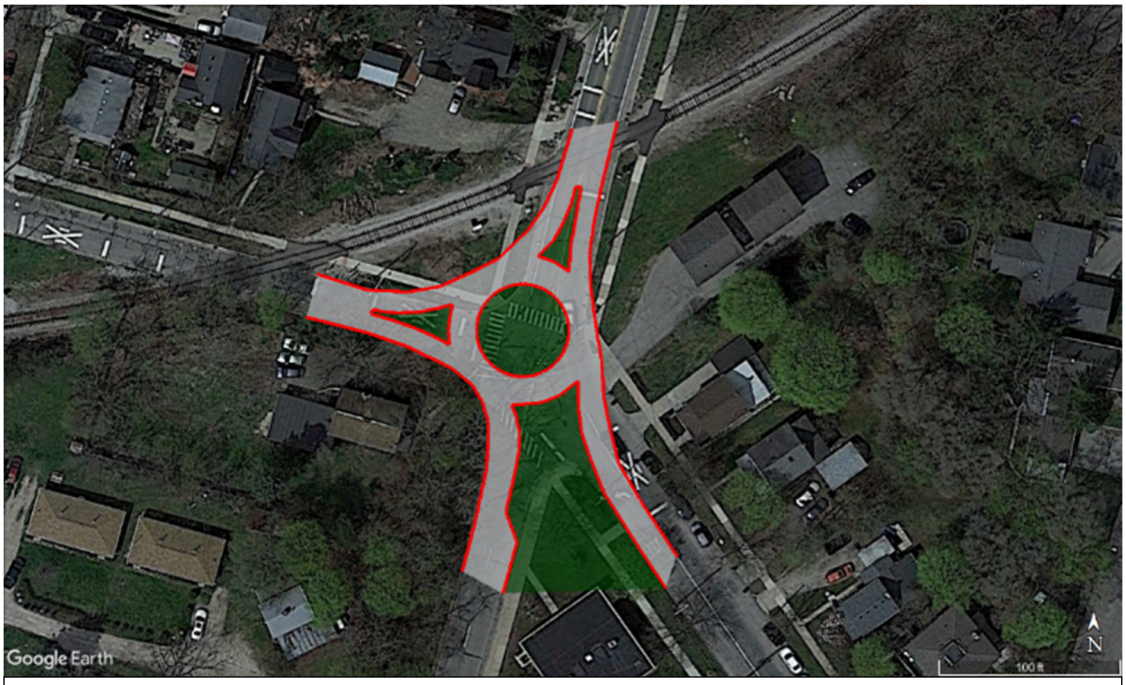


Figure 19: Option C – Reconfigure intersection as one-lane roundabout. Maintains access for all existing movements. Would eliminate the intersection beacons. Depicted is a roundabout with about 90' outside diameter.

Option D Characteristics

This option configures the intersection as an urban compact one lane roundabout, but premised on two-way traffic on Moore St. It has 14 conflict points, 36% fewer than existing conditions. They include seven with pedestrians, three merging and four diverging vehicle paths.

Option D Pro

All current vehicle movements are facilitated with this option, while adding two-way traffic to Moore. The roundabout would provide the best anticipated safety performance. With this option, all pedestrian crossings would benefit from the splitter islands being refuges for pedestrians crossing the approaches. This allows for a pedestrian crossing of Moore St where one is not currently provided.

Option D Con

This option may need a small amount of road right of way to accommodate the roundabout and the pedestrian sidewalks around the intersection.

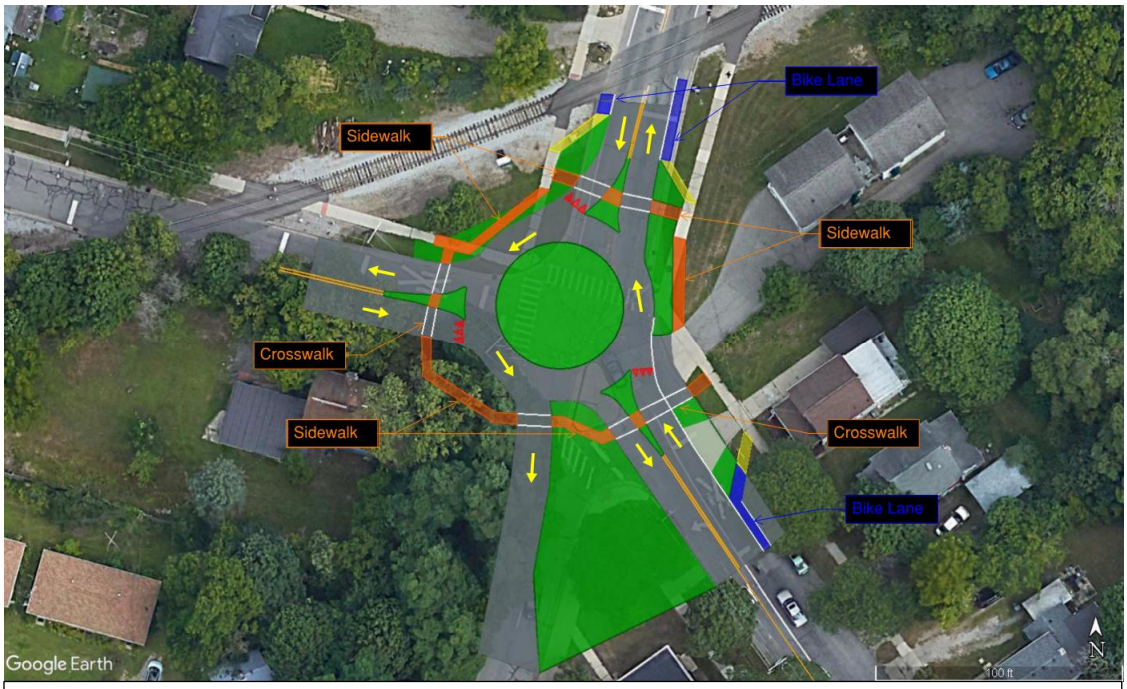


Figure 20: Option D – Same as Option C but facilitating two-way movements on Moore St. Reconfigure intersection as one-lane roundabout. Maintains access for all existing movements. Would eliminate the intersection beacons. Depicted is a roundabout with about 90' outside diameter.

Operational Analysis

Options involving primarily pavement marking improvements or the addition of new islands to better channelize vehicles are expected to have minimal impacts on the operations of the intersection. While adding islands, one of the options eliminated the direct left movement from Moore to Longshore, which would then divert traffic further north along Pontiac to other E/W routes. A more substantial improvement to the intersection involves reconfiguring the intersection to a single lane compact roundabout. An analysis was performed for a single lane compact roundabout, both with and without the conversion of Moore to 2-way traffic, at this location.

TABLE 8: Moore at Pontiac at Longshore Roundabout (Option C) Analysis

	2019 LOS		2040 LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
Pontiac Trail SB	B	A	**D**	A
Longshore EB	A	A	A	A
Moore WB	A	B	A	C
Overall	B	A	C	C

TABLE 9: 2-Way Moore at Pontiac at Longshore Roundabout (Option D) Analysis

	2040 LOS	
	AM Peak	PM Peak
Pontiac Trail SB	**D**	A
Longshore EB	A	A
Moore WB	A	C
Overall	C	C

OHM Recommendation

We recommend the City implement Short Term Option 2 at the earliest opportunity. Regarding the longer-term improvements, each of the alternatives represents compromises in terms of cost, improving safety, restricting movements and the resultant changes to travel patterns. With all this considered, OHM endorses Option C or D depending on whether Moore remains one-way or is converted to two-way traffic. These represent the best balance between the competing interests. We recommend that an opinion of probable cost be developed for Option C for inclusion in the City's Capital Improvement Plan.

C. Barton Dr / Pontiac Trail

Figure 21: Barton Dr at Pontiac Trail

Existing Characteristics

Barton Dr and Pontiac Trail is a signalized intersection. Both roads are generally two-lanes, but Pontiac Trail has left turn lanes provided at the intersection. On-street bike lanes exist on Barton Dr east of Pontiac Trail, but not to the west. Rather, on-street parking is allowed on Barton to the west of Pontiac Trail. Bike lanes are provided north and south along Pontiac Trail but are eliminated through the intersection where the left turn lanes are developed. As a standard configuration intersection, there are the usual 24 pedestrian conflict points and the 32 vehicle conflicts, of which 16 are vehicle crossing paths, eight are merging and eight are diverging movements.

Traffic counts (capacity calculations) and direct field observations have pointed to congestion issues during the commuter peak periods, especially in the morning. In the a.m. period, significant backups occur for both eastbound and southbound approaches.

Existing Configuration Pro

The configuration is traditional, so drivers and non-motorized users are well familiar with navigating it. Pedestrians seeking to cross have a positive guidance by way of pedestrian signal heads. North and southbound left turns are relatively heavy and can utilize dedicated left turn lanes on their approaches.

Existing Configuration Con

There are not on-street bike lanes available for three of the four intersection approaches. Though the east-west left turn volumes are not particularly heavy, they do not have dedicated left turn lanes to improve the safety of their turning movements. Providing such a feature would require either the elimination of the on-street bike lanes on Barton within the intersection or widening the intersection resulting in the need for additional road right-of-way (ROW) and reconstructing the traffic signal. A particularly heavy turning movement, the eastbound right turns, also merits but does not have access to, a dedicated right turn lane. This again would require additional ROW. The presence of pedestrian signal heads does not completely mitigate the inherent conflicts of vehicles turning on green across their crossing paths.

Basis for Developing Alternate Layouts

There are competing interests at this intersection that tend to be mutually exclusive with conventional measures due to the limited road ROW that is available. Three of the options that have been developed may be viewed as prioritizing the needs of one mode of travel over others. The roundabout option attempts to provide benefits for both motorized and non-motorized users.

Option A Characteristics

This option favors improvement for motorists by seeking to reduce congestion delays. It removes the on-street parking along the south side of Barton from Chandler Rd to Pontiac Trail. It then uses the extra space to provide an eastbound right turn lane. The number and types of conflict points will not be altered with this modification.

Option A Pro

This option is relatively easy to implement, requiring only changes to traffic signs and pavement markings. Delays to eastbound traffic would be reduced by about one half.

Option A Con

This option eliminates on-street parking for the residents along this block of Barton. As the parking lane(s) are not fully used, this option could be considered a loss to bicyclists as they would have to directly share the road with moving traffic instead of skirting it by riding in the parking lane. This option also does nothing to reduce pedestrian or motorist conflict points.

Option B Characteristics

This option favors improvement for non-motorists on Barton Dr by seeking to provide additional bike facilities. It removes the on-street parking along Barton from Chandler Rd to Pontiac Trail. It uses the extra space to provide eastbound and westbound on-street bike lanes, matching the cross section of Barton east of Pontiac Trail. This option keeps bikes in the road through the intersection.

Figure 22: Option B – Extended Bike Lanes

Option B Pro

This option is relatively easy to implement, requiring only changes to traffic signs and pavement markings. The option will not impact vehicle delays while providing a critical link in the City's bike network along Barton Dr.

Option B Con

This option eliminates on-street parking for residents along this block of Barton. However, it does nothing to reduce pedestrian or motorist conflict points.

Option C Characteristics

This option favors improvement for non-motorists on Pontiac Trail by seeking to provide additional bike facilities. It widens the sidewalk along Pontiac Trail to 10' so to function as a multi-use path from Starwick Dr to a point about 275' south of Barton. This provides a linkage between the on-street bike lanes of Pontiac Trail north and south of Barton Dr. Alternately, Pontiac Trail could be symmetrically widened so that the additional bicycle facility is on-street, though this will likely be the more expensive option due to adjustments needed with the widening to the drainage system of the street.

Option C Pro

This option will not impact vehicle delays while providing a critical link in the City's bike network along Pontiac Trail.

Option C Con

Providing a multi-use pathway may require additional right-of-way to avoid the loss of street trees, but this could be accomplished through easements rather than fee simple purchases. Alternately, additional right-of-way would not be required for widening the street, but the street trees in the green belt would need to be removed.

Option D Characteristics

This option configures the intersection as an urban compact one lane roundabout. It would have an inscribed circle from 70' to 80' diameter. The image below is for one with about 80' outer diameter. Small ROW triangles would be needed in each corner, measuring up to roughly 20'x20'x28' to allow for relocating the sidewalks. The smaller the inscribed circle, the smaller the ROW triangles would be. This option has 16 conflict points, 71% fewer that existing conditions. They include eight with pedestrians, four merging and four diverging vehicle paths. Ramps would be provided to allow bicyclists the option of riding up onto a widened multi-use path and crossing as pedestrians or remaining on the street and taking the lane to negotiate the roundabout.

Figure 23: Option D – Urban Compact Roundabout. The yellow triangles are showing potential road right-of-way needed to maintain sidewalk connectivity.

Option D Pro

All current vehicle movements are facilitated with this option. It is the option with the best anticipated safety performance. The reduction of about 71% fewer conflict points tracks nicely with national experience with the actual reduction of crashes when signalized intersections are converted to roundabouts. With this option, all pedestrian crossings would benefit from the splitter islands being refuges for pedestrians crossing the approaches. The slow circulating speed of about 12 to 16 mph is conducive to bike riders sharing the road through the intersection. It would be possible to also provide ramps to and from the on-street bike lanes for users that are not confident with riding through roundabouts. The sidewalks between the ramps within this junction would be widened from their usual 5' dimension to 10' wide so to function as multi-use paths in the immediate area of the roundabout.

Option D Con

This option may need a small amount of road right of way and possibly rights to grade to accommodate the roundabout and the pedestrian sidewalks around the intersection. Would remove on-street parking in the immediate vicinity of the roundabout as part of developing the splitter island(s). This option was not well received by residents living near the intersection, as traffic would now be closer to their front yards and right of way would be required. This option also did not show well in handling future vehicular traffic demands during peak periods.

Operational Analysis

Operationally, two alternatives have been evaluated and found to provide near term value for this intersection, the addition of a dedicated EB right-turn lane and implementation of a modern roundabout. For the addition of the right-turn lane, a storage length of 150 ft was used. One alternative that was investigated, included the addition of dedicated left-turn lanes for EB/WB Barton, however analysis found that this did not provide substantial improvements to traffic operations.

An analysis was performed for the addition of a right-turn lane under both 2019 and 2040 traffic volumes. In the 2019 analysis, Option A is expected to result in modest improvements during the AM Peak. The 2019 PM peak model did not show significant changes to the LOS after adding the EB right-turn lane. This is primarily since most traffic is heading to the M-14 interchange in the PM, whereas in the AM traffic was coming from the interchange.

Due to the substantial projected volume increase at this location, the existing intersection is expected to operate with very poor level of service in 2040. 2040 operational analysis information is provided below. This deterioration in LOS is primarily attributed to the new developments on the horizon along Pontiac between Barton and Dhu Varren. With the Option A addition of a right-turn lane, the intersection overall improves to LOS D in the AM and PM peak periods, but individual movements are still projected to experience lengthy delays.

TABLE 10: Barton at Pontiac Option A (Right Turn Lane) Analysis

	2019 LOS/Delay		2040 LOS/ Delay	
	AM Peak	PM Peak	AM Peak	PM Peak
EB Existing	C (34.9)	C (23.4)	**F (89.6)**	**F (91.0)**
EB Option A	B (17.6)	B (18.6)	**D (42.8)**	**E (71.5)**
Intersection Existing	C (33.1)	C (20.2)	**F (88.2)**	**D (54.1)**
Intersection Option A	C (21.4)	B (19.1)	**D (41.3)**	**D (38.5)**

An analysis was performed for a single lane compact roundabout under both 2019 and 2040 traffic volumes. In the 2019 analysis, all approaches were found to operate at LOS C or better under existing traffic conditions, with an overall LOS of B for AM and PM peaks. Due to the substantial projected volume increase at this location, the 2040 single lane roundabout analysis shows poor level of service on multiple approaches and has an overall LOS D in both the AM and PM peak periods.

TABLE 11: Barton at Pontiac Option D (Roundabout) Analysis

	2019 LOS		2040 LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
Pontiac Trail SB	B	A	**F**	B
Barton EB	C	A	**E**	A
Pontiac Trail NB	A	B	A	**E**
Barton WB	A	C	A	**F**
Overall	B	B	**D**	**D**

OHM Recommendation

There are competing interests at this intersection that cannot be served with conventional traffic signal timing or geometric improvements due to limited road ROW available. Signalized and roundabout options were evaluated based on the needs of all users. OHM weighed the benefits of these options and did not find that any one option would solve the long term demands of all users at the intersection. Rather than identify a geometric change to the intersection, it is believed that this intersection would be best served by implementing Traffic Demand Management techniques. The issues at the intersection are primarily related to the significant peak hour traffic demands. Shifting intersection demand to be spread throughout the day provides the most opportunity for delay relief.

D. Dhu Varren Rd / Pontiac Trail

Figure 24: Dhu Varren Rd at Pontiac Trail

Existing Characteristics

Dhu Varren Rd and Pontiac Trail currently operates as a two-way STOP controlled intersection, with the controls applying to Dhu Varren. Both roads are generally two-lanes. On-street bike lanes exist on Pontiac Trail through the intersection. Bike lanes begin on Dhu Varren east of the intersection but do not extend into the intersection. Currently, there is sidewalk along the east side of Pontiac Trail south of Dhu Varren

and along the north side of Dhu Varren east of Pontiac Trail. Thus, the only pedestrian crossing provided is the east leg of Dhu Varren. Eventually, it is anticipated that pedestrian facilities are going to be provided in all quadrants of the intersection. As a standard configuration intersection, there would then be the usual 24 pedestrian conflict points and 32 vehicle conflicts, of which 16 are vehicle crossing paths, eight are merging and eight are diverging movements.

Traffic counts and direct field observations have pointed to congestion issues during the commuter peak periods, especially in the morning. When traffic signal volume warrants are considered, this location meets the criteria for the installation of a signal.

Existing Configuration Pro

The configuration is traditional, so drivers and non-motorized users are well familiar with navigating it.

Existing Configuration Con

Southbound traffic on Pontiac Trail, arriving from rural Ann Arbor Township, is traveling at relatively high speeds. Combined with current traffic volumes, Dhu Varren experiences high delays in finding acceptable gaps to turn onto Pontiac Trail. This is especially the case in the a.m. peak period.

Basis for Developing Alternate Layouts

Current issues at this intersection involve vehicle safety and delay concerns, given the dearth of facilities for other modes of travel. Any potential solution should anticipate a future where additional facilities are provided for bicyclists and pedestrians.

Option A Characteristics

This option assumes the installation of a traffic signal to reduce congestion delays for Dhu Varren. To improve safety for left turning vehicles, Pontiac Trail and Dhu Varren would be widened to provide left turn lanes while also providing for on-street bike lanes for all approaches. The number and types of conflict points will not be altered with this modification.

Option A Pro

This option is relatively straightforward to implement, requiring pavement widening, adding traffic signs, and modifying pavement markings as part of installing the signal. Delays to westbound traffic would be reduced by about one half.

Option A Con

This option does nothing to reduce pedestrian or motorist conflict points. SB Pontiac Trail traffic arriving at the signal during a green phase will not be constrained to slow down.

Option B Characteristics

This option configures the intersection as an urban compact one lane roundabout. It would have an inscribed circle from 80’ to 90’ diameter. If 90’, then small ROW triangles would be needed in each corner measuring roughly 25’x25’x35’ to allow for providing sidewalks. The smaller the inscribed circle, the smaller the ROW triangles would be. This option has 16 conflict points, 71% fewer than existing conditions. They include eight with pedestrians, four merging and four diverging vehicle paths.

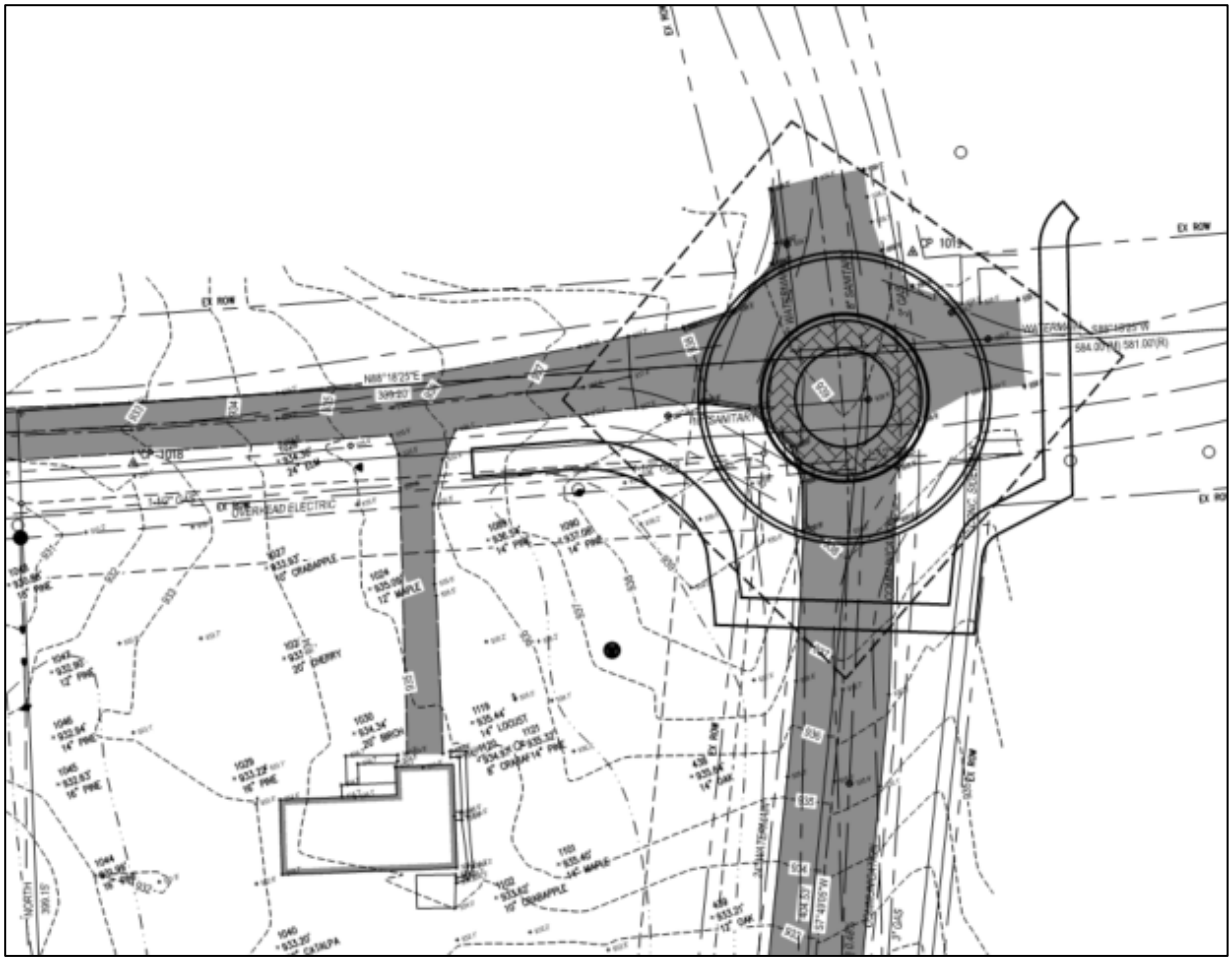


Figure 25: Option B – Dhu Varren at Pontiac Trail Roundabout

Option B Pro

All current vehicle movements are facilitated with this option. It is the option with the best anticipated safety performance. The reduction of about 71% fewer conflict points tracks nicely with national experience with the actual reduction of crashes when signalized intersections are converted to roundabouts. With this option, all pedestrian crossings would benefit from the splitter islands being refuges for pedestrians crossing the approaches. The slow circulating speed of about 15 to 18 mph is conducive to bike riders sharing the road through the intersection. It would be possible to also provide ramps to and from the on-street bike lanes for users that are not confident with riding through roundabouts. The sidewalks between the ramps within this junction would be 10' wide so to function as multi-use paths in the immediate area of the roundabout.

Option B Con

This option may need a small amount of road right of way and possibly rights to grade to accommodate the roundabout and the pedestrian sidewalks around the intersection.

Operational Analysis

A signal warrant analysis was performed to determine if a signal may be warranted at the intersection. Based off the current traffic volumes that were collected in November 2019, a signal is warranted. The

tables below show existing LOS compared to LOS with the addition of a traffic signal in both 2019 and 2040 analysis years. The change of intersection control at this location is expected to reduce intersection delay and provides acceptable level of service values during the peak periods for both analysis years.

TABLE 12: Pontiac at Dhu Varren Option A (Signal Control) 2019 Analysis

	Existing Configuration LOS/Delay		Option A LOS/ Delay	
	AM Peak	PM Peak	AM Peak	PM Peak
Pontiac SB	A (1.8)	A (1.9)	B (19.3)	A (8.1)
Dhu Varren EB	B (14.4)	B (12.5)	A (6.7)	B (11.0)
Pontiac NB	A (0)	A (0)	A (4.8)	B (12.0)
Dhu Varren WB	**E (36.2)**	C (24.2)	B (11.5)	B (19.1)
Overall	A (9.0)	A (7.5)	B (13.3)	B (13.7)

TABLE 13: Pontiac at Dhu Varren Option A (Signal Control) 2040 Analysis

	Existing Configuration LOS/Delay		Option A LOS/ Delay	
	AM Peak	PM Peak	AM Peak	PM Peak
Pontiac SB	A (1.9)	A (1.8)	B (13.9)	A (8.3)
Dhu Varren EB	C (16.4)	B (14.0)	B (11.2)	B (11.2)
Pontiac NB	A (0.0)	A (0.0)	A (3.7)	B (15.6)
Dhu Varren WB	**F (107.0)**	**F (70.4)**	C (23.3)	C (26.9)
Overall	C (25.0)	C (21.7)	B (12.7)	B (18.2)

An analysis was performed for a single lane compact roundabout under both 2019 and 2040 traffic volumes. All approaches were found to operate at LOS A for both analysis years.

TABLE 14: Pontiac at Dhu Varren Option B (Roundabout) Operational Analysis

	2019 LOS		2040 LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
Pontiac SB	A	A	A	A
Dhu Varren EB	A	A	A	A
Pontiac NB	A	A	A	A
Dhu Varren WB	A	A	A	A
Overall	A	A	A	A

OHM Recommendation

OHM endorses the construction of an urban compact roundabout (Option B) as representing the best option to meet the needs of all users. A roundabout at this location will facilitate the change of roadway character from rural to urban entering the city. A roundabout will also help to reduce speeds, and provide traffic congestion relief for Dhu Varren traffic during peak periods. We recommend that an opinion of probable cost be developed for Option B for inclusion in the City's Capital Improvement Plan.

E. Broadway St / Maiden Ln / Moore St / Plymouth Rd

Figure 26: Broadway St / Maiden Ln / Moore St / Plymouth Rd

Existing Characteristics

Broadway St at Plymouth Rd / Maiden Ln /Moore St is a signalized intersection. Broadway and Plymouth are 5-lane roads with center lanes for left turns, Maiden Lane is a 3-lane with a center left turn lane, and Moore has two northwest bound travel lanes, one parking lane along its north side and is one-way to the northwest. None of these roads have on-street bike lanes. Left turn signal phases are provided for all intersection approaches.

While the intersection appears to have a standard configuration, Moore is one-way directionally away from the intersection. This means that there are only 19 pedestrian conflict points and the 19 vehicle conflicts, of which eight are vehicle crossing paths, five are merging and six are diverging movements.

Current traffic counts (capacity calculations) and direct field observations have pointed to congestion issues during both commuter peak periods, but especially in the evening.

Existing Configuration Pro

The configuration is traditional, so drivers and non-motorized users are well familiar with navigating it. Pedestrians seeking to cross have a positive guidance by way of pedestrian signal heads. North and southbound left turns are relatively heavy and utilize dedicated left turn lanes with separate signal phases on their approaches.

Existing Configuration Con

There are no on-street bike lanes available for any of the intersection approaches. Adding capacity to this conventional intersection would require widening the intersection for additional through or auxiliary turning lanes, resulting in the need for additional road right-of-way (ROW) and reconstructing the traffic signal. The presence of pedestrian signal heads does not completely mitigate the inherent conflicts of vehicles turning on green across their crossing paths.

Basis for Developing Alternate Layouts

There are competing interests at this intersection that tend to be mutually exclusive with conventional measures due to the limited road ROW that is available. Two options have been evaluated in detail for this location, a multi-lane roundabout option and a signalized option, where Moore Street could be converted to two-way in both options.

Option A Characteristics

This option configures the intersection as an urban two-lane roundabout. But Maiden Ln would only need one entering and departing lane. The image shown is for a 150' diameter inscribed circle roundabout. It also shows how it would be possible to accommodate Moore St being converted from one-way to two-way traffic. ROW triangles would be needed for all corners. This option has 16 conflict points, 57% fewer that existing conditions. They include eight with pedestrians, four merging and four diverging vehicle paths.

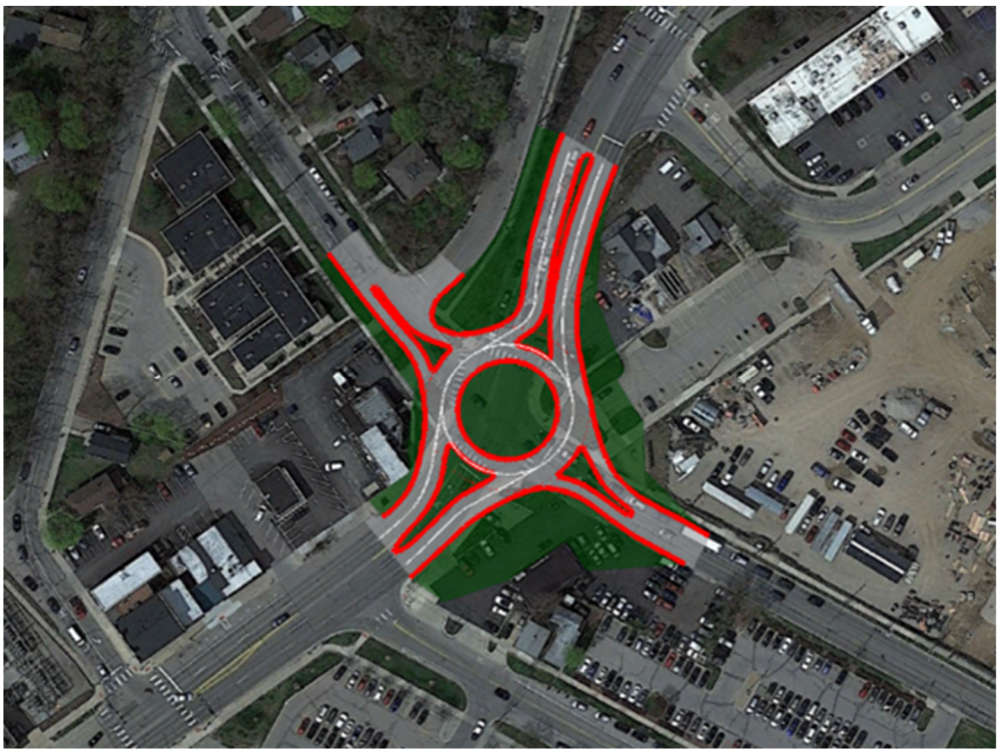


Figure 27: Option A – Broadway St / Maiden Ln / Moore St / Plymouth Rd

Option A Pro

All current vehicle movements are facilitated with this option. It is the option with the best anticipated safety performance. The reduction of about 57% fewer conflict points tracks nicely with national experience with the actual reduction of crashes when signalized intersections are converted to roundabouts. With this option, all pedestrian crossings would benefit from the splitter islands being refuges for pedestrians crossing the approaches. Per current PROWAG guidance, the two-lane crossings could have enhanced pedestrian protections utilizing either RRFB or PHB signals. The slow circulating speed of about 16 to 20 mph is conducive to bike riders sharing the road through the intersection. It would be possible to also provide ramps to and from any on-street bike lanes when such facilities become available for users. In the meantime, sidewalks within this junction should be widened from their usual 5' dimension to 10' wide so to function as multi-use paths in the immediate area of the roundabout.

Option A Con

Likely to need additional road right of way and possibly rights to grade to accommodate the roundabout and the pedestrian sidewalks around the intersection. Might need to remove a limited amount of on-street parking on Moore St in the immediate vicinity of the roundabout as part of developing the splitter island(s). Should PHB signals be provided at the crossings, vehicle operations will be impacted during signal activation.

Option B Characteristics

This option maintains the existing signal control at the intersection. Over time, it is assumed that the City will continue to make timing adjustments, which would keep the signal optimized for operational performance. In maintaining signalization, this option could accommodate a potential 2-way conversion for Moore Street.

Option B Pro

By maintaining the existing signal control, this alternative is familiar to roadway users. Timing adjustments allow for slightly improved operations at this location.

Option B Con

This option does not provide a reduction in conflict points or speeds.

Operational Analysis

Under existing conditions, this intersection operates at an overall LOS C during both the AM and PM peak periods. This intersection is at the heart of Lower Town Area and is known for traffic congestion, which did not show up in the existing condition models. The analysis shows the signalized operations begin to deteriorate in the future during the PM peak, operating at an LOS E condition.

TABLE 15: Broadway/Plymouth at Maiden/Moore Signal Control Operational Analysis

	2019 LOS/Delay		2040 LOS/ Delay	
	AM Peak	PM Peak	AM Peak	PM Peak
Plymouth SB	C (31.9)	**D (38.5)**	C (30.6)	**E (69.5)**
Broadway NB	B (10.7)	C (23.0)	C (22.1)	**D (39.4)**
Maiden WB	C (32.1)	**D (42.9)**	**D (37.5)**	**D (52.2)**
Overall	C (20.5)	C (33.4)	C (27.7)	**D (52.1)**

As an alternative to the existing signalized intersection, this location was analyzed for the addition of a roundabout. The RODEL analysis showed that the Broadway/Plymouth approaches would need to be 2-lane approaches, Moore would not have an approach as it is one-way (NWB) away from the intersection, and Maiden would be single lane approach plus a right-turn bypass lane. All approaches will perform at acceptable LOS during both analysis years, with overall intersection LOS at A in the 2040 AM peak and C in the 2040 PM peak.

TABLE 16: Broadway/Plymouth at Maiden/Moore Roundabout Operational Analysis

	2019 LOS		2040 LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
Plymouth SB (2 lane)	A	B	A	**D**
Broadway NB (2 lane)	A	A	A	B
Maiden WB (1 lane + bypass)	A	B	A	**D**
Overall	A	A	A	C

Changing Moore to a 2-way street would change travel patterns in the heart of the Lower Town Area. Making assumptions on how traffic would reroute through the area, we prepared traffic models to account for this change. The results from the optimized Synchro analysis are found below. AM and PM peaks were found to be similar to the optimized conditions above, with LOS staying the same but with slight increases in delays. While this intersection may see slightly more delay, the other intersections impacted by the conversion will see substantially less delay. Traffic that previously had to route down Pontiac Trail to the intersection of Swift at Broadway, then turn onto Broadway to reach Wall Street and Maiden Lane can now travel straight down Moore Street onto Maiden Lane, removing up to 50% of the southbound traffic at the Swift intersection.

TABLE 17: Broadway/Plymouth at Maiden/Moore Signal Control with 2-Way Moore Analysis

	2040 LOS/Delay	
	AM Peak	PM Peak
Plymouth SB	**D (52.2)**	**E (64.0)**
Moore EB	**E (79.3)**	**F (81.9)**
Broadway NB	C (31.5)	**D (42.3)**
Maiden WB	C (31.0)	**E (59.4)**
Overall	**D (43.9)**	**D (54.6)**

Taking the roundabout a step further, we have also analyzed the roundabout under the Moore converted to 2-way scenario. The results are showing slight degradation from the 1-way Moore option.

TABLE 18: Broadway/Plymouth at Maiden/Moore Roundabout with 2-Way Moore Analysis

	2040 LOS	
	AM Peak	PM Peak
Plymouth SB (2 lane)	A	**D**
Moore EB (1 lane)	C	A
Broadway NB (2 lane)	B	B
Maiden WB (1 lane + bypass)	A	**D**
Overall	B	C

OHM Recommendation

OHM endorses Option B (signalized intersection) with a 2-way conversion for Moore St. While this option shows a slight degradation in delay at the intersection, the overall improvement to the Lower Town Area will be substantial. In turning Moore St to a 2-way roadway, traffic from the north, with a destination of the University of Michigan medical campus, will no longer need to weave down Pontiac Trail, to Swift, onto Broadway and then turn at either Wall St or Maiden Ln. Travel patterns will be simplified with the direct connection from Pontiac Trail to Moore St, which becomes Maiden Ln. The addition of the

previously recommended roundabout at Pontiac / Moore / Longshore intersection will further facilitate traffic movements onto the converted Moore St.

While the roundabout option showed promise for vehicular operations, these didn't factor in the need for pedestrian signals to cross the roundabouts multi-lane approaches. In addition, the roundabout option was not looked upon favorably during team meetings with the city or with the public, primarily due to past experience in the city with multi-lane roundabouts.

F. Barton Dr / Plymouth Rd

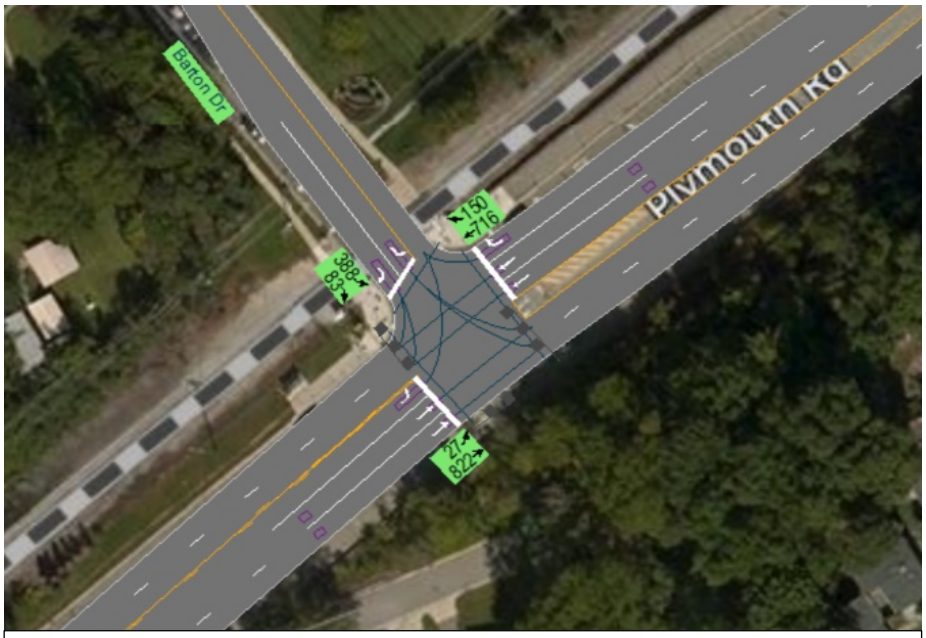


Figure 28: Current (2019) turning movements at Barton Dr / Plymouth Rd for the a.m. peak period.

Existing Characteristics

Barton Dr at Plymouth Rd is a signalized tee intersection. Plymouth is a 5-lane road with center lane for left turns, Barton Dr is a 3-lane with a center left turn lane. None of these roads have on-street bike lanes within the intersection, though Barton Dr has a bike lane for the northwest direction that starts about 400' from the intersection. A dedicated left turn signal phase is provided for the northeast bound Plymouth Rd movement to Barton. Further, there is a right turn signal overlap for Barton.

The intersection has a standard tee configuration. This means that there are 12 pedestrian conflict points and the nine vehicle conflicts, of which three are vehicle crossing paths, three are merging and three are diverging movements.

Current traffic counts (capacity calculations) and direct field observations have pointed to congestion issues during the a.m. commuter peak periods for Barton Dr.

Existing Configuration Pro

The configuration is traditional, so drivers and non-motorized users are well familiar with navigating it. Pedestrians seeking to cross have a positive guidance by way of pedestrian signal heads.

Con

There are no on-street bike lanes available for any of the intersection approaches. Adding a lane for extra capacity to the deficient movement, Barton's left turn to Plymouth, would require widening not just the intersection but also the railroad grade crossing with Barton. The presence of pedestrian signal heads does not completely mitigate the inherent conflicts of vehicles turning on green across their crossing paths.

Basis for Developing Alternate Layouts

The congestion is time limited to the a.m. peak, so extraordinary or expensive options are not likely to be cost effective. Only one option has been developed that may be viewed as balancing the benefits with a modest cost to implement.

Option A Characteristics

This option retains the current overall configuration but makes lane use modifications to the Barton Dr approach. Rather than the two approach lanes functioning as separate left and right turn only lanes, the option allows for a dual left turn. The outside lane would then be shared with the right turning movements. This change would not impact the number or type of conflict points.

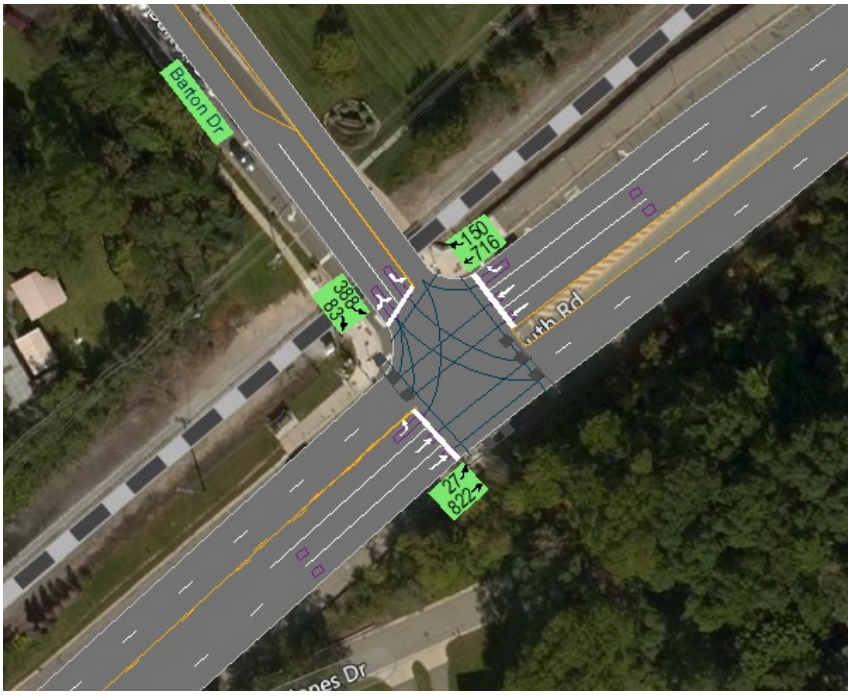


Figure 29: Option A – Provided Dual Left Turn Lanes

Option A Pro

It provides additional capacity for the highest volume turning movement. It is anticipated that approach delay for Barton Dr might be reduced by about 20 sec. per vehicle, improving the level of service from E to D. This gain is not at the expense of the Plymouth Rd traffic movements. The costs to implement would

be minor and involve changes to the traffic signal displays and programming, signs and pavement markings.

Option A Con

The lane storage for Barton's approach is limited, and the prospect of dual turns considered unusual enough that the use of the outside lane for left turns will not result in a reasonable lane balance, which will impact the amount of congestion relief achieved. In addition, dual turn lanes tend to lead to a greater potential for side-swipe crashes. This option would result in the elimination of the right turn signal phase overlap for Barton Dr.

Operational Analysis

Under existing conditions, the southwest bound left approach experiences lengthy delays and operates at a poor level of service. Projected increases in traffic volumes are expected to further decrease the operational performance at this location. Providing a dual left turn lane at this intersection (Option A) provides a reduction in delay for this approach during all analysis periods. With the improvement seen in the AM peak period for existing and future conditions, changing the lane configuration on the Barton approach to Plymouth was considered.

TABLE 19: Barton at Plymouth Option A (Dual Turn Lane) Analysis

	2019 LOS/Delay		2040 LOS/ Delay	
	AM Peak	PM Peak	AM Peak	PM Peak
SEB Left Existing	**F (85.2)**	**E (62.8)**	**F (191.3)**	**E (69.2)**
SEB Left Option A	**D (52.6)**	**D (53.4)**	**E (55.7)**	**D (54.85)**

OHM Recommendation

An additional left turn lane could provide a considerable reduction in delay during the peak periods. Ultimately, the option to modify this intersection to provide southbound dual left-turn movements was rejected due to confusing geometry and the potential for side-swipe crashes during the left-turn movement. The railroad crossing the north leg of the intersection further complicates the intersection. Based on input from public and team meetings, the option to change this intersection was abandoned.

G. Barton Dr at M-14 EB Off Ramp

This intersection is under the jurisdiction of MDOT, therefore any improvements at this intersection are subject to the approval of MDOT. MDOT has a study planned to begin in 2021 for this interchange, therefore we are not providing recommendations at this location, rather providing our analysis for information purposes only.

Operational Analysis

The intersection of M-14 EB off ramp and Barton is currently under stop control on all approaches. During the AM peak period, the SB approach is failing, with an LOS F and 54.4 seconds of delay. In the PM peak period, the WB approach is failing, with an LOS F and 59.5 seconds of delay. These delays are projected to increase with the future traffic growth at this location.

A signal warrant analysis was preformed to determine if a signal may be warranted at the intersection based on the existing traffic volumes. The existing volumes were collected in November 2019. The analysis

indicated that Warrant 2: Four-Hour Vehicular Volume was met. Incorporating a signal at this location could substantially reduce delays during peak periods in both analysis years.

TABLE 20: Barton at EB M-14 Ramp Signalized Operational Analysis

	2019 LOS/Delay		2040 LOS/ Delay	
	AM Peak	PM Peak	AM Peak	PM Peak
EB - Barton	C (28.1)	B (10.2)	C (25.7)	A (8.8)
WB - Barton	C (25.4)	B (19.3)	C (23.9)	B (18.6)
SB - Ramp	B (15.8)	C (24.9)	B (17.4)	C (27.2)
Overall	C (21.6)	C (20.1)	C (21.5)	B (19.9)

H. Speed Management

As part of the public engagement process, several roadway segments were identified as having speeding concerns. They included:

1. Plymouth Rd from Broadway St to Barton Dr
2. Pontiac Trail from Swift St to Dhu Varren Rd
3. Division St from Catherine St to Broadway St
4. Broadway St from Division St/Beakes St to Plymouth Rd
5. Traver Rd from Moore St to Barton Dr

Except for Traver Rd, these roads are considered City Major streets. Traver is a local street. The speeding concerns were verified during the RSA field reviews. As part of the project's Vision /Goals /Alternatives (VGA) workshop, a suite of speed management treatments was compiled to assist in addressing the concerns. The treatments suggested for speed management are:

- Narrow vehicle travel lanes
- Add on-street bike lanes
- Allow on-street parking
- Install speed actuated (radar) warning signs
- Add in-road R1-6 signs as a gateway feature
- Install roundabouts
- Install median islands
- Provide hybrid pedestrian beacons (RRFB's)
- Construct curb extensions (neckdowns)
- Add or relocate pedestrian crossings to improve visibility
- Install speed humps for non-major (local) roads

But the VGA did not specifically identify where such treatments should be deployed along the corridors in question. City staff requested that we bring together the various treatments in a comprehensive manner. Some of the recommendations described here are duplicated from other portions of the study but are included as they can contribute to speed management efforts.

Plymouth Rd from Broadway St to Barton Dr

This 5-lane section is already planned to be refurbished by the City with narrowed lanes (10') to add an on-street bike lane for SW bound cyclists. Beyond these changes, which are already in the works, we recommend installing:

Radar Speed Signs - for both NE and SW Plymouth Rd. The recommended placement of these is closer to the mid-point of the stretch between Broadway and Barton. For westbound, it may be beneficial to place prior to reaching the proposed mid-block pedestrian crossing.

Enhanced Pedestrian Crossing - Finally, we urge that a portion of the center lane be removed in favor of a raised median island, to provide a refuge for a new pedestrian crossing to provide access to an AAATA bus stop along SW Plymouth. This crossing should include RRFB signals and a gateway treatment.

These recommendations are depicted in the figure below.

Figure 30: Speed Management for Plymouth Rd from Moore/Maiden Lane to Barton Dr

Roundabouts - There is one location along this stretch of the Pontiac Trail corridor that would benefit from the construction of a roundabout; the intersection of Pontiac Trail at Moore St /Longshore St. Roundabouts are known to reduce vehicle speeds, reduce crash potential and provide gaps for entering traffic.

Enhanced Pedestrian Crossings - There is one new enhanced pedestrian crossing location identified, at Swift St. In addition, the existing pedestrian crossing at Taylor St is a good candidate for the addition of RRFB's, as it is located near a school and a heavily used crossing location.

Radar Speed Signs - Finally, there is one location where a radar speed sign should be installed. This is for SB, north of Indianola Ave. This placement would complement the existing radar speed sign that exist in the same vicinity for NB traffic.

These recommendations are depicted in the figures below.

Figure 31a: Speed Management for Pontiac Trail from Swift St to Barton Dr

Roundabouts - There are two locations along this corridor that would benefit from the construction of roundabouts, at the new residential development (Village of Ann Arbor) located north of Skydale Dr, and at Dhu Varren Rd. Roundabouts are known to reduce vehicle speeds, reduce crash potential and provide gaps for entering traffic.

Enhanced Pedestrian Crossings - There are four new pedestrian crossings identified, at Northside Ave, at the south drive of Rudolf Steiner School, at Skydale Dr, and at Montana Way. We recommend the crossing at Montana Way include gateway treatments. The proposed crossing at Rudolf Steiner School driveway is a good candidate for the addition of RRFB's, as it is located near a school. There is a relatively new crossing at St. Regis Dr with a RRFB included.

Radar Speed Signs - Finally, there is one location where a radar speed sign should be installed. This is for NB, north of Starwick Dr. This placement would complement the existing radar speed sign that exists in the same vicinity for SB traffic.

These recommendations are depicted in the figures below.

Figure 31b: Speed Management for Pontiac Trail from Barton Dr to Dhu Varen Rd

Division St from Catherine St to Beakes St / Broadway St

Currently one-way NB, on-street parking is allowed along the west side of Division St. This corridor would benefit by adding:

Curb Extensions - Providing curb extensions (neckdowns) at three locations will reduce the crossing distances for pedestrians and better delineate the parking lanes. These locations are the northwest corner of Division at Catherine St, the northwest corner at Kingsley St, and the southwest corner at Detroit St. This latter location would be done in conjunction with changes to the junction of Division at Beakes St / Broadway St, identified earlier in this report (Study Alternatives).

Enhanced Pedestrian Crossings – It is recommended to add a new pedestrian crossing with RRFB signals located across Division north of Detroit. Due to the complexity of this area, the high number of crashes and amount of pedestrian activity, we are also recommending consideration for the inclusion of RRFB's for each of the major pedestrian crossings.

Radar Speed Signs – We are recommending the installation of a radar speed sign for NB Division located south of the intersection with Carey St. This will help to slow traffic down entering into this complicated intersection.

These recommendations are depicted in the figure below.

Figure 32: Speed Management for Division St from Catherine St to Broadway St

Broadway St from Division St/Beakes St to Plymouth Rd

As previously noted, this report (Study Alternatives) contains ideas for the reconfiguration of the junction of Beakes, Broadway and Division. If implemented, the changes should contribute significantly to speed management along this street. We are also recommending:

Speed Radar Signs - Installation of a radar speed signs for NB and SB Broadway, to be located near the middle of the Broadway Bridge. The intent of these is to slow traffic entering into the heart of Lower Town (NB) and also heading into the junction of multiple roads at the south end of the bridge.

Curb Extensions - There should also be a curb extension for the southwest corner of Broadway at Swift, which will reduce the crossing distance for pedestrians and better delineate the parking lane or bus stop.

These recommendations are depicted in the figure below.

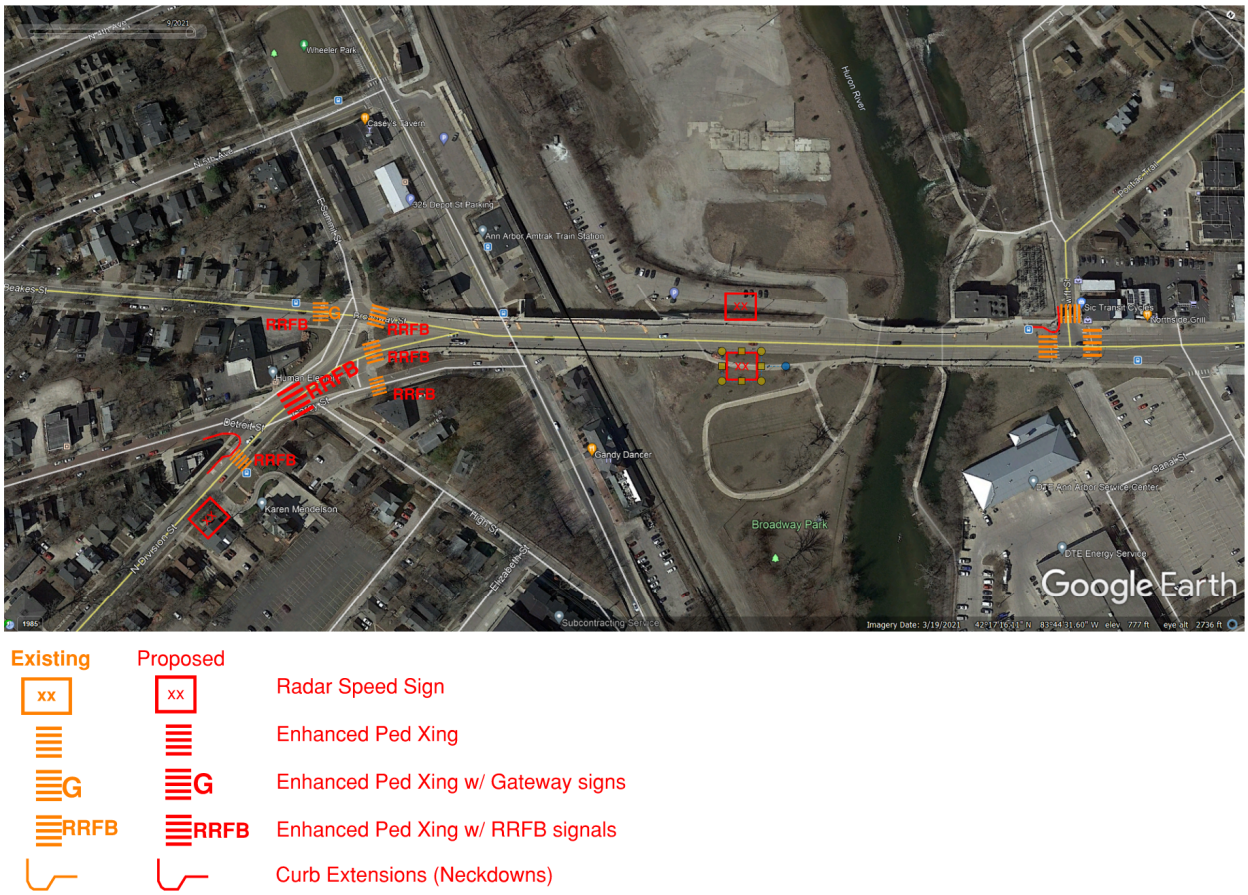


Figure 33: Speed Management for Broadway St from Beakes St to Plymouth Rd

Speed Humps - As a non-major (local) street, Traver Rd allowed us to consider the use of speed humps. There are already a few speed humps installed, however, the spacing between them is greater than recommended by most safety organizations. We recommend that two more be constructed, the first about midway between Pear St and the Ann Arbor Railroad grade crossing and the other south of Bowen St.

Enhanced Pedestrian Crossings - Gateway treatment should be added to the existing pedestrian crossing of Traver south of John A Woods Dr.

Sidewalks - Finally, we recommend that the roadway segment of Traver between John A Woods Dr and Barton Dr be narrowed by eliminating the on-street parking against the northwest side of the street. Depending on how far the curb line is shifted, there would then be room for either a multi-use pathway (10' wide) or a standard width sidewalk (5') and an on-street bike lane for southwest bound cyclists. The on-street parking along the southeast side of Traver should be allowed to remain in either case. Sidewalk shall be provided for both sides of the street. Sidewalk along the southeast side of Traver can be added in the traditional fashion, outside of the existing roadway, near the right-of-way line.

These recommendations are depicted in the figure below.

Figure 34: Speed Management for Traver Rd from Moore St to Barton Dr

IV. STUDY RECOMMENDATIONS

The comprehensive reviews, audits, analyses, interviews, and engagement sessions allowed the study team to dive deep into multiple concepts and alternatives. This information is pulled together here to provide the City with a structured format for recommendations and best practices in the study area. The study recommendations have been divided by transportation mode and are listed alphabetically by location. Because there are overlaps in how certain proposed improvements may improve more than one mode, there may be a degree of duplication between the various tables.

A. Pedestrian Recommendations

Study recommendations anticipated to address pedestrian network concerns are summarized in Table 21.

Table 21: Lower Town Pedestrian Recommendations

Proposed Improvement / Location		Cost (1)	Sources
Widen boardwalk to ~ 14'		$$$	RSA
Barton Drive	M-14 to Longshore Drive		
Install sidewalk along desire line		$$	RSA
Barton Drive	at Huron Bridge Park		
Install W11-2 + W16-4P, clear brush		$	Ped Xing
Barton Drive	470' W of Brede Place		
Fill in fence / railing gap		$$	RSA
Barton Drive	140' W of Brede Place		
Fill in sidewalk gaps		$$	RSA
Barton Drive	Chandler Road to Pontiac Trail		
Provide ped ramps		$$	RSA
Barton Drive	and Chandler Road		
Fill in sidewalk gaps		$$	RSA
Barton Drive	Pontiac Trail to Starwick Drive		
Provide ped ramps		$$	RSA
Barton Drive	and Starwick Drive		
Install W11-2 + W16-9P + High Emphasis Ped Xing		$	Ped Xing
Barton Drive	and Starwick Drive		
Upgrade ped ramps so ADA compliant		$$	RSA
Beakes Street	Broadway Street to Summit St		
Position R1-6 signs in road on lane lines (Gateway signs)		$	RSA
Beakes Street	Broadway Street to Summit St		
Provide grade separated crossing of RR		$$$$	Public
Broadway Park	State Street to Amtrak RR		
Eliminate protrusions in bridge railings		$$	RSA
Broadway Street	at Bridge over RR/River		
Provide speed management along corridor		$$$	RSA
Broadway Street	Plymouth Rd to Beakes Street		

Note (1) – Cost Ranges: $ < 2K, $$ <25k, $$$ < 250K, $$$$ > 250K

Proposed Improvement / Location		Cost [1]	Sources
Upgrade ped ramps so ADA compliant		$$	RSA
Broadway Street	Division Street to Carey Street		
Fill in sidewalk gaps		$$	RSA
Broadway Street	Maiden Lane to Plymouth Road		
Replace outdated ped signals with countdown heads		$$	RSA
Broadway Street	Maiden Lane to Moore St		
Replace outdated ped signals with countdown heads		$$	RSA
Broadway Street	and Swift Street		
Install sidewalk along desire line		$	RSA
Broadway Street	Swift Street to Riverwalk (B2B) Trail		
Upgrade ped ramps so ADA compliant		$$	RSA
Chandler Road	and Barton Drive		
Provide speed management along corridor		$$$	RSA
Division Street	Beakes Street to Catherine Street		
Relocate ped crossing for visibility		$$$	RSA
Division Street	Carey Street to Detroit Street		
Place R1-6 in road at ped crossing (Gateway signs)		$	RSA
Division Street	Carey Street to Detroit Street		
Narrow traffic lane widths		$	RSA
Division Street	Carey Street to Detroit Street		
Leading Pedestrian Interval		$$	Crash
Division Street	and Catherine St		
Improve street lighting for ped crossings		$$	RSA
Fuller Road	and Maiden Lane		
Install sidewalk along desire line		$$	RSA
Fuller Road	and Maiden Lane		
Upgrade ped ramps so ADA compliant		$$	RSA
High Street	and State Street		
Install W11-2		$	Ped Xing
Maiden Lane	and Island Drive		
Upgrade ped ramps so ADA compliant		$$	RSA
Moore Street	Pontiac Trail to Longshore Drive		
Channelize school parking lot driveway		$$$	RSA
Northside STEAM	Taylor Street to Peach Street		
Reconfigure parking lot for angle of stalls		$$	RSA
Northside STEAM	at South parking lot		
Provide new drive for parent loading zone		$$$$	RSA
Northside STEAM	and Pontiac Trail		

Note (1) – Cost Ranges: $ < 2K, $$ <25k, $$$ < 250K, $$$$ > 250K

Proposed Improvement / Location		Cost [1]	Sources
Provide speed management along corridor		$$$	RSA
Plymouth Road	Barton Drive to Broadway Street		
Upgrade ped ramps so ADA compliant		$$	RSA
Plymouth Road	and Barton Drive		
Increase greenbelt separation road from sidewalk		$$$	Stakeholders
Plymouth Road	N of Broadway Street		
Install lighting for sidewalk /pathway		$$$	RSA
Plymouth Road	Broadway Street to Arbor Springs		
Replace outdated ped signals with countdown heads		$$	RSA
Plymouth Road	and Broadway Street		
Provide speed management along corridor		$$$	RSA
Pontiac Trail	Dhu Varren to Swift Street		
Install series of roundabouts through the corridor		$$$$	Brainstorm
Pontiac Trail	Dhu Varren to Swift Street		
High Emphasis Ped Xing and Gateway Signs		$	Ped Xing
Pontiac Trail	and Montana Way		
High Emphasis Ped Xing		$	Ped Xing
Pontiac Trail	and Polson Street		
High Emphasis Ped Xing		$	Ped Xing
Pontiac Trail	and Skydale Drive		
High Emphasis Ped Xing and Gateway Signs		$	Ped Xing
Pontiac Trail	at Rudolf Steiner School south driveway		
High Emphasis Ped Xing		$	Ped Xing
Pontiac Trail	and Northside Ave		
Add RRFB and Gateway signs to ped crossing signs		$$	Public
Pontiac Trail	and Taylor Street		
Install street lighting		$$$	RSA
Pontiac Trail	Moore Street to Swift Street		
Fill in sidewalk gaps		$$	RSA
Starwick Drive	Barton Drive to 175' N of Barton Dr		
Upgrade ped ramps so ADA compliant		$$	RSA
Swift Street	and Pontiac Trail		
High Emphasis Ped Xing		$	Ped Xing
Swift Street	and Pontiac Trail		
Encourage UM Hospital/Medical Ctr to flex shift hours		$$	Public
System-wide			
Adding street trees as ped amenity		$$$	Public
System-wide			

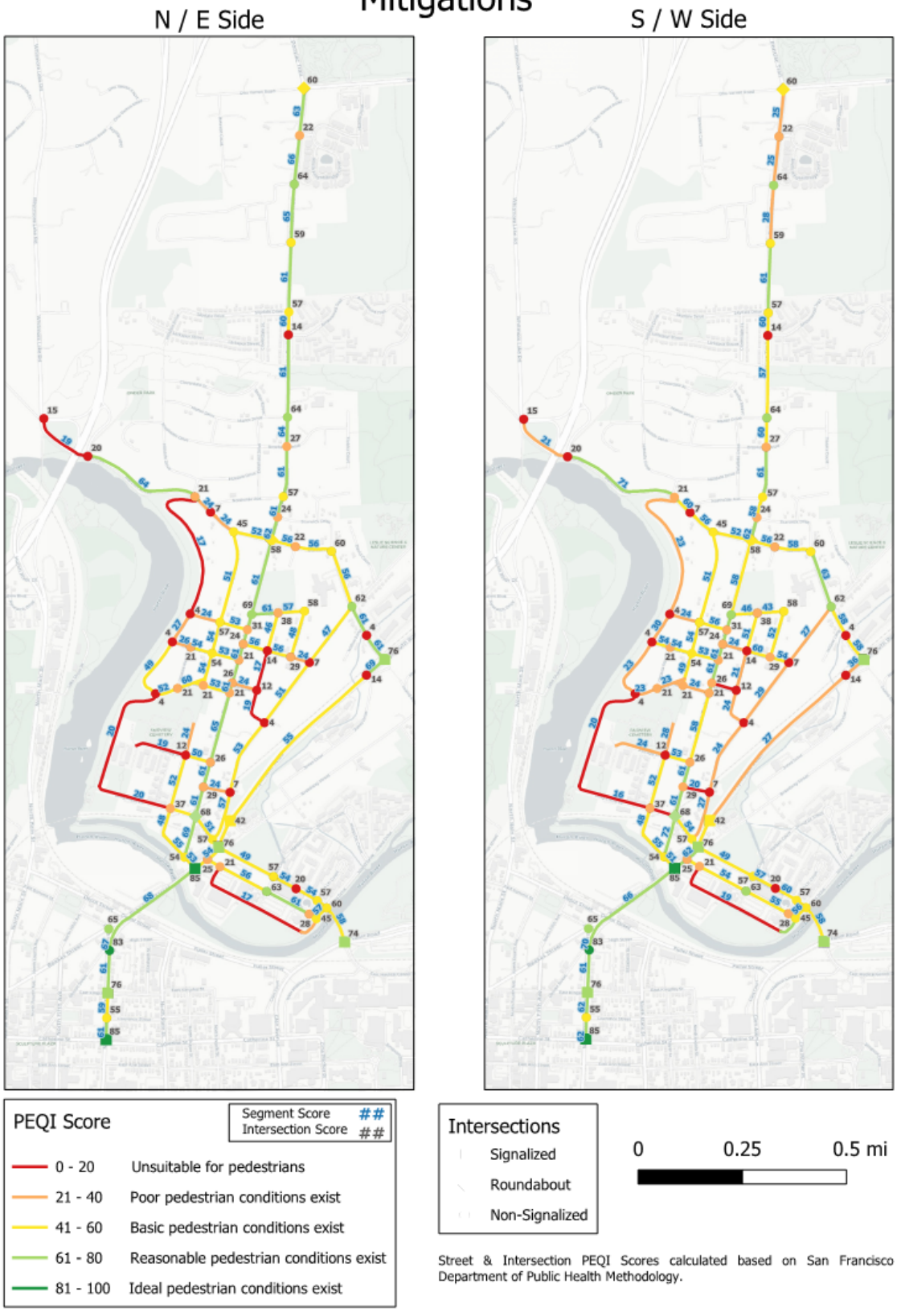
Note (1) – Cost Ranges: $ < 2K, $$ <25k, $$$ < 250K, $$$$ > 250K

Proposed Improvement / Location		Cost [1]	Sources
Install sidewalk (both sides)		$$$	RSA
Traver Street	Barton Drive to John A Woods Drive		
Upgrade ped Xing so ADA compliant		$$	RSA
Traver Street	at Ann Arbor RR Xing		
Fill in fence / railing gap		$	RSA
Traver Street	130' N of Moore St		
Upgrade ped ramps so ADA compliant		$$	RSA
Traver Street	and Moore Street		
High Emphasis Ped Xing		$	Ped Xing
Traver Street	and Moore Street		

Note (1) – Cost Ranges: $ < 2K, $$ <25k, $$$ < 250K, $$$$ > 250K

To provide a measure of what impact these recommendations would have on the pedestrian environment, we updated the PEQI scores for the Lower Town area. The following figure illustrates the improvements and should be compared to the existing conditions related in Figure 6 on page 11.

Pedestrian Environmental Quality Index (PEQI) Mitigations



Street & Intersection PEQI Scores calculated based on San Francisco Department of Public Health Methodology.

B. Bicycle Recommendations

Study recommendations anticipated to address bicycle network concerns are summarized in Table 22.

Table 22: Lower Town Bicycle Recommendations

Proposed Improvement / Location		Cost (1)	Sources
Widen boardwalk to ~ 14'		$$$	RSA
Barton Drive	M-14 to Longshore Drive		
Provide on-street bike lanes		$$$$	RSA, Stakeholders
Barton Drive	Huron Bridge Park to Pontiac Trail		
Provide on-street bike lanes		$$$$	RSA, Public
Barton Drive	Traver Street to Plymouth Road		
Reconfigure intersection		$$$$	Crash, RSA
Beakes Street	Broadway Street to Division St		
Provide grade separated crossing of RR		$$$$	Public
Broadway Park	State Street over Amtrak RR		
Install electronic speed warning radar		$$	RSA
Broadway Street	S of Swift Street		
Eliminate protrusions in bridge railings		$$	RSA
Broadway Street	at Bridge over RR/River		
Provide on-street bike lanes		$$$$	Stakeholders, Public
Broadway Street	Plymouth Rd to Beakes Street		
Provide bike blvd		$$$	Public
Chandler Road	Barton Drive to Swift Street		
Install electronic speed warning radar		$$	RSA
Division Street	S of Carey Street		
Provide on-street bike lanes		$$$	RSA, Public
Division Street	Broadway Street to N of Kingsley Street		
Add R3-17bP BIKE LANE ENDS sign		$	RSA
Division Street	S of Carey Street		
Provide on-street bike lanes		$$	RSA
Maiden Lane	Broadway Street to Fuller Road		
Provide on-street bike lanes		$$	RSA
Moore Street	and Broadway Street		
Provide on-street bike lanes		$$	Brainstorm
Plymouth Road	Barton Drive to Broadway Street		
Provide on-street bike lanes		$$	Public
Pontiac Trail	Moore Street to Swift Street		
Provide EVehicle & EBike charging stations		$$$	Public
System-wide			

Note (1) – Cost Ranges: $ < 2K, $$ <25k, $$$ < 250K, $$$$ > 250K

Proposed Improvement / Location	Cost [1]	Sources
Enforcement re: obstructions blocking bike lanes		RSA
System-wide		
Better sign beginning / ending of bike lanes	$$$	RSA
System-wide		
Better sign bike route wayfinding	$$$	RSA, Public
System-wide		
Widen on-street bike lanes to 6' adjacent to parked vehicles	$$$$	RSA
Wall Street Broadway Street to Maiden Lane		

Note (1) – Cost Ranges: $ < 2K, $$ <25k, $$$ < 250K, $$$$ > 250K

To provide a measure of what impact these recommendations would have on the Bicycling environment, we updated the BEQI scores for the Lower Town area. The following figure illustrates the improvements and should be compared to the existing conditions related in Figure 7 on page 12.

Bicycle Environmental Quality Index (BEQI) Mitigations

Street & Intersection BEQI Scores calculated based on San Francisco Department of Public Health Methodology.

C. Transit Recommendations

Study recommendations anticipated to address transit network concerns are summarized in Table 23.

Table 23: Lower Town Transit Recommendations

Proposed Improvement / Location	Cost [1]	Sources
Provide transit signal priority Barton Drive and Pontiac Trail	$$$$	Public
Provide transit signal priority Barton Drive and Plymouth Rd	$$$	Public
Eliminate 1 on-street parking stall blocking bus stop Broadway Street S of Swift Street	$	RSA
Provide Park N Ride lot for commuters Dhu Varren Road at Olson Park	$$	RSA
Provide Park N Ride lot for commuters M-14 WB Off Ramp Barton Drive at Whitmore Lake Rd	$$$$	Brainstorm
Upgrade bus stop so ADA compliant Moore Street at Broadway Street	$$	RSA
Install bus stop landing pad/ connection to sidewalk Plymouth Road 540' S of Jones Drive	$$	RSA
Install bus stop landing pad/ connection to sidewalk Plymouth Road N of Broadway Street	$$	RSA
Provide transit signal priority Plymouth Road and Broadway Street	$$$	Public
Increase frequency of transit along corridor Pontiac Trail Dhu Varren to Swift Street	$$$$	Stakeholders, Public
Install bus stop landing pad/ connection to sidewalk Pontiac Trail and Knightsbridge Circle	$$	RSA
Install bus stop landing pad/ connection to sidewalk Pontiac Trail at Rudolf Steiner School	$$	RSA
Install bus stop landing pad/ connection to sidewalk Pontiac Trail N of Brookside Drive	$$	RSA
Install bus stop landing pad/ connection to sidewalk Pontiac Trail N of Starwick Drive	$$	RSA
Install bus stop landing pad/ connection to sidewalk Pontiac Trail N of Taylor Street	$$	RSA
Install bus stop landing pad/ connection to sidewalk Pontiac Trail N of Apple Street	$$	RSA
Improve frequency & reliability of transit System-wide	$$$$	Stakeholders, Public
Provide Park N Ride lot(s) for commuters outside City Limits System-wide	$$$$	Brainstorm

Note (1) – Cost Ranges: $ < 2K, $$ <25k, $$$ < 250K, $$$$ > 250K

D. Vehicle Recommendations

Study recommendations anticipated to address vehicle network concerns are summarized in Table 24.

Table 24: Lower Town Vehicle Recommendations

Proposed Improvement / Location		Cost (1)	Sources
Install ITS-based CMS for drivers re: alternate routes		$$$$	RSA
Ann Arbor Railroad			
Pave shoulder		$$$	Crash
Barton Drive	M-14 to Brede Place		
Repair pavement edge rutting		$$	RSA
Barton Drive	Near Brede Pl		
Update signal timing		$$	Crash, RSA
Barton Drive	and Pontiac Trail		
Eliminate on street parking for EB bike lane		$	RSA
Barton Drive	and Pontiac Trail		
Modernize traffic signal to box span		$$$	RSA
Barton Drive	and Pontiac Trail		
Install W1-1L + W13-1P (15 mph) signs		$	RSA
Barton Drive	150' W of Starwick Dr		
Remove WB W1-1a sign		$	RSA
Barton Drive	315' W of Traver St		
Update signal timing		$$	Crash, Traffic
Barton Drive	and Plymouth Rd		
Repair guardrail		$$	RSA
Barton Drive	540' W of Brede Pl to Brede Place		
Install W1-2 for WB		$	RSA
Barton Drive	200' E of Chandler Rd		
Reconfigure intersection		$$$$	Crash, RSA
Beakes Street	At Broadway Street and Division St		
Install electronic speed warning radar		$$	RSA
Broadway Street	N of Swift Street		
Provide speed management along corridor		$$$	RSA
Broadway Street	Plymouth Rd to Beakes Street		
Update signal timing		$$	Crash, RSA
Broadway Street	Maiden Lane to Moore St		
Provide transit signal priority		$$$$	Public
Broadway Street	Maiden Lane to Moore St		
Reconfigure intersection		$$$$	Crash, RSA
Broadway Street	Maiden Lane to Moore St		
Update signal timing		$$	Crash, RSA
Broadway Street	at Swift Street		

Note (1) – Cost Ranges: $ < 2K, $$ <25k, $$$ < 250K, $$$$ > 250K

Proposed Improvement / Location		Cost [1]	Sources
Provide transit signal priority		$$$$	Public
Broadway Street	at Swift Street		
Post for one-way travel		$	RSA
Canal Street	Wall Street to Island Dr		
Install electronic speed warning radar		$$	RSA
Division Street	N of Carey Street		
Provide speed management along corridor		$$$	RSA
Division Street	Beakes Street to Catherine Street		
Update signal timing		$$	Crash
Division Street	at Kingsley St		
Modernize traffic signal to box span		$$$	RSA
Division Street	at Kingsley St		
Provide transit signal priority		$$$$	Public
Division Street	at Kingsley St		
Update signal timing		$$	Crash, Traffic
Division Street	at Catherine St		
Modernize traffic signal to box span		$$$	RSA
Division Street	at Catherine St		
Provide transit signal priority		$$$$	Public
Division Street	at Catherine St		
Provide transit signal priority		$$$$	Public
Fuller Road	at Maiden Lane		
Extend guardrail to protect lite pole		$$	RSA
Fuller Road	W of Maiden Lane		
Single lane roundabout		$$$$	Crash, RSA
Moore Street	Pontiac Trail to Longshore Drive		
Channelize school parking lot driveway		$$$	RSA
Northside STEAM	Taylor Street to Peach Street		
Reconfigure parking lot for angle of stalls		$$	RSA
Northside STEAM	at South parking lot		
Provide new drive for parent loading zone		$$$$	RSA
Northside STEAM	and Pontiac Trail		
Provide speed management along corridor		$$$	RSA
Plymouth Road	Barton Drive to Broadway Street		
Provide speed management along corridor		$$$	RSA
Pontiac Trail	Dhu Varren to Swift Street		
Install series of roundabouts through the corridor		$$$$	Brainstorm
Pontiac Trail	Dhu Varren to Swift Street		
Single lane roundabout		$$$$	Crash, Traffic
Pontiac Trail	at Dhu Varren		

Note (1) – Cost Ranges: $ < 2K, $$ <25k, $$$ < 250K, $$$$ > 250K

Proposed Improvement / Location		Cost [1]	Sources
Replace W1-2a with W1-1L + W13-1P (20 mph)		$	RSA
Pontiac Trail	110' N of Swift St		
Replace 2 W1-8s with W1-7		$	RSA
Pontiac Trail	and Swift Street		
Provide EV & Ebike charging stations		$$$	Public
System-wide			
Encourage UM Hospital/Med Ctr to flex shift hours		$$	Public
System-wide			
Improve sign maintenance for age, condition & knock downs		$$	RSA
System-wide			
Improve pavement markings for condition & location		$$	RSA
System-wide			
TSM / TDM measures		$$$$	Traffic
System-wide			
Repair pavement		$$$	RSA
Traver Street	Barton Drive to John A Woods Drive		
Convert to Two-Way Traffic		SSS	Traffic / Brainstorm
Moore Street			
Relocate R1-2 to proper location re ped crossing		$	RSA
Wall Street	and Canal Street		

Note (1) – Cost Ranges: $ < 2K, $$ <25k, $$$ < 250K, $$$$ > 250K

V. CONCLUSIONS

This report has been prepared to assist the City of Ann Arbor in the identification and actualization of opportunities to improve safety and mobility within the Lower Town study area. The report is based on a variety of efforts to evaluate safety within the study area, make observations of actual field conditions, data collection and other information available at the time of the study. The recommendations contained herein were arrived at through collaboration between the OHM project team and the City of Ann Arbor. Countless project and public meetings were used to guide the decision-making process. The recommendations included in this report are for consideration by the City and are in no way intended to preclude the City in their deliberations as to whether to accept the recommendations. This report also does not preclude the identification of additional issues pertaining to safety or mobility by City staff, or the emergence of new issues over time.