US Route 11

Corridor Improvement Study

Between Stone Spring Road

And Mosby Road

Final Report

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Prepared for

Virginia Department of Transportation

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Table of Contents

1.0 Introduction 1

1.1 Purpose / Background 1

1.2 Study Area 1

2.0 Existing Conditions 2

2.1 Existing Traffic Conditions and Data 2

2.1.1 Intersection of US 11 and Stone Spring Road/Erickson Avenue 3

2.1.2 Intersection of US 11 and Mosby Road 4

2.1.3 US 11 Commercial Access Segment 5

2.1.4 Erickson Avenue and Pear Street 6

2.2 Existing Safety Conditions 7

2.2.1 Study Area Safety Conditions 7

2.3 Existing Access Spacing 12

2.4 Public Involvement Part 1 / Survey Results 12

3.0 Improvement Alternatives 13

3.1 Summary and Development of Alternatives 13

3.1.1 Intersection of US 11 and Stone Spring Road/Erickson Avenue 13

3.1.2 Intersection of US 11 and Mosby Road 13

3.1.3 US 11 Commercial Access Portion 13

3.1.4 Intersection of Erickson Avenue and Pear Street 13

3.2 Discussion of US 11 and Stone Spring Road/Erickson Avenue 13

3.2.1 Alternative 1 – Conventional Intersection Upgrades on US 11 13

3.2.2 Alternative 2A – Quadrant Roadway Intersection 13

3.2.3 Alternative 2B – Quadrant Roadway Intersection with Drop Lane Approaches 14

3.3 Discussion of US 11 and Mosby Road 14

3.3.1 Alternative 3 – Re-Phasing of Mosby Road 14

3.3.2 Alternative 4 – Widening of Mosby Road 14

3.4 Discussion of US 11 Commercial Access Portion 15

3.4.1 Alternative 5 – Commercial Access Management Improvements on US 11 15

3.5 Discussion of Erickson Avenue and Pear Street 15

3.5.1 Alternative 6 – Signalization 15

3.5.2 Alternative 7 – Reduced Conflict Intersection 16

4.0 Future Traffic Forecasting and Modeling 16

4.1 Traffic Forecasting and Methodology 16

4.2 Future Traffic Model Results 17

4.2.1 Future Model Results for US 11 and Stone Spring Road/Erickson Avenue 17

4.2.2 Future Model Results for US 11 and Mosby Road 18

4.2.3 Space Mean Speed on US 11 within the Study Area 19

4.2.4 Future Model Results for Erickson Avenue and Pear Street 19

4.2.5 Future Combined Alternative SimTraffic Results 20

4.3 Public Involvement Part 2 / Survey Results 21

5.0 Conclusions and Recommendations 21

5.1 Short-Term Recommendations 21

5.2 Preferred Alternative 21

5.3 Final Conclusions 21

Appendix 22

US 11 Proposed Alternatives Memo 23

US 11 Access Management Memo 24

US 11 Design Considerations Memo and Cost Estimate 25

US Route 11 Corridor Improvement Study Framework Document 26

Public Involvement Phase 2 Survey Summary Presentation 27

1.0 INTRODUCTION

1.1 Purpose / Background

US Route 11 (S. Main Street) in the City of Harrisonburg is a minor arterial route with several observed operational deficiencies. These include issues at the signalized intersection at Erickson Avenue/Stone Spring Road, which has major left turning movements on all approaches. The signalized intersection at Mosby Road is ranked the #3 Potential Safety Improvement (PSI) in the VDOT Staunton District. In addition, there are existing safety concerns on the corridor extending to the south. US 11 from Pleasant Hill Road to Covenant Drive is ranked the #5 PSI roadway segment in the District.

The City of Harrisonburg has also established, through a land development traffic study, that there will be future operational and safety issues at the intersection of Erickson Avenue and Pear Street that may not be adequately resolved with signalization. The City has developed a preliminary concept for an innovative intersection treatment that will be refined and advanced.

The purpose of this Strategically Targeted and Affordable Roadway Solutions (STARS) project is two-fold. First, it will evaluate operational and safety conditions and identify short- and long-term improvements that can be programmed into the Virginia Department of Transportation's (VDOT) Six-Year Improvement Program (SYIP) for a segment of S. Main Street from Mosby Road to Stone Spring Road/Erickson Avenue. Second, it will evaluate and perform preliminary design work for the conceptual treatment developed by the City of Harrisonburg for the Erickson Avenue and Pear Street intersection.

The S. Main Street alternatives evaluation will consider operational and safety improvements through geometric design, access management improvements, lane utilization/repurposing and innovative intersection or interchange configurations. Advancement of work on the intersection of Erickson Avenue and Pear Street will include an assessment of the function and feasibility of the conceptual treatment, analysis of beneficial modifications to this concept, and preliminary design plan development.

A stakeholder working group was developed to solicit input and feedback as the study progressed from initial existing conditions, traffic and safety analysis, and subsequently potential improvements for the corridor. The stakeholders group included several local jurisdictions as well as VDOT and consultant staff in order to develop a framework for the study. This framework contained the review of key assumptions and methodology approaches, provide comments and pivotal concerns surrounding concepts and details of the proposed solutions. The stakeholder group for the study included representatives from:

- VDOT Staunton District and Central Office
- The City of Harrisonburg
- Central Shenandoah Planning District Commission
- ATCS Team (consultants to VDOT for the Study)

The assumptions used in the framework document align with the standards and guidance from VDOT's Traffic Operations and Safety Analysis Manual (TOSAM), the VDOT Road Design manual, and applicable City standards.

1.2 Study Area

The study area primarily consists of a section of US 11 (S. Main Street) between the functional areas of the Mosby Road to Stone Spring Road/Erickson Avenue intersections, approximately 0.25-mile in length. Also, as part of this STARS effort, ATCS advanced concept designs for the intersection of Erickson Avenue and Pear Street. The study corridor includes three primary intersections and direct access points to adjacent properties. The significant study corridor intersections are as follows:

1. US 11 and Stone Spring Road/Erickson Avenue (signalized)
2. US 11 and Mosby Road (signalized)
3. Erickson Avenue and Pear Street (unsignalized)

A map view of the study area can be seen in **Figure 1**.

Figure 1: US 11 STARS Study Area Within the City of Harrisonburg

2.0 Existing Conditions

2.1 Existing Traffic Conditions and Data

Existing conditions of the study area on US 11 were evaluated for the year 2019. Field data was collected as part of the new Harrisonburg High School Traffic Impact Analysis (TIA) effort for a new high school campus in the vicinity of the study area. The TIA was prepared by Monteverde Engineering & Design Studio and completed September 2019. Data collection for the TIA was conducted between April and June 2019 to account for school traffic and included two hour weekday AM & PM peak hour turning movement counts. The City of Harrisonburg provided the study team with the most current Synchro files available. The data collected as part of the TIA was incorporated into these models.

For the Erickson Avenue design work, the City of Harrisonburg provided the Synchro models used for the 2017 Wenger-Burkholder Residential Development Traffic Impact Analysis. An aerial map showing the intersections and their existing turning movement counts is shown below in **Figure 2**.

Figure 2: Study Intersections Existing Turning Movement Counts

Traffic operations analysis and simulation was performed using Synchro 10/SimTraffic 10 software for all the study intersections along the arterial corridor. Inputs and analysis methodologies are consistent with VDOT's Traffic Operations and Safety Analysis Manual (TOSAM).

Measures of effectiveness (MOEs) for intersections include Synchro/SimTraffic output for HCM 6th Edition control delay (sec/veh)/microsimulation delay (sec/veh) and 95th percentile queue length (ft)/maximum queue length (ft). Unsignalized intersection operations are reported as Stop Control Approach delay (sec/veh) and 95th percentile queue length.

Corridor-level MOEs for US 11 are reported from SimTraffic and include space mean speed (mph) and travel time (min:sec) for NB and SB travel from Stone Spring Road/Erickson Avenue to Mosby Road.

Through initial analysis of the models and data, the stakeholder group determined that the PM peak hour experienced heavier delay in critical movements compared to the AM peak hour. As such, only the PM peak hour has been evaluated for the purposes of this study.

The existing traffic and geometric conditions at each intersection and the corridor in between are discussed in the sections that follow.

2.1.1 Intersection of US 11 and Stone Spring Road/Erickson Avenue

The intersection of US 11 and Stone Spring Road/Erickson Avenue is an existing eight phase, signalized intersection at the northern end of the study area. The left turn phasing on each approach is currently permitted/protected with flashing yellow arrows. An aerial image of the existing geometry at the intersection is shown in **Figure 3**.

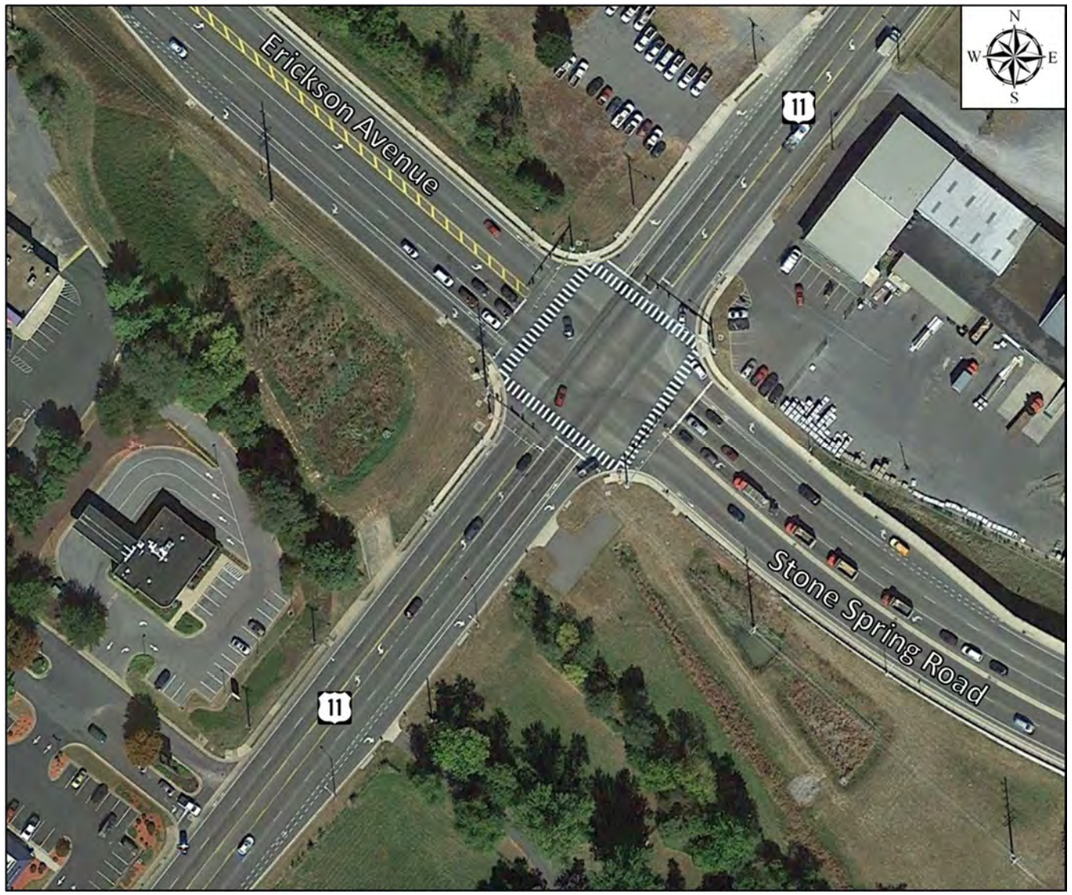


Figure 3: Existing Geometry at the Intersection of US 11 and Stone Spring Road/Erickson Avenue

Potential geometric modification to the eastern approach is limited due to its location on a bridge structure used to cross over the nearby railroad tracks. The cost of widening this structure to accommodate additional/modified lanes was factored into the development of alternatives.

Synchro analysis results for the existing PM peak hour are shown below in **Table 1**.

Table 1: Existing PM Analysis Results for US 11 and Stone Spring Road/Erickson Avenue

PM Peak Hour Delay, LOS, and Queue Summary					
			2019 Existing Configuration		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Stone Spring Road/Erickson Avenue	South Main Street	NBL	26.6	C	281
		NBT	29.2	C	315
		NBR	19.4	B	96
	South Main Street	SBL	35.8	D	287
		SBT	38.8	D	341
		SBR	28.5	C	45
	Erickson Avenue	EBL	40.3	D	81
		EBT	65.8	E	264
		EBR	43.5	D	79
	Stone Spring Road	WBL	57.1	E	296
		WBT	48.3	D	265
		WBR	37.2	D	110
	Overall		44.0	D	-

The intersection currently experiences heavy delay for the through and left turn movements on all approaches, particularly on the side streets. The northbound and southbound through and left turn movements on US 11, critical for moving vehicles through the corridor, are of particular concern to this study and a main focus area for improvement.

2.1.2 Intersection of US 11 and Mosby Road

The intersection of US 11 and Stone Spring Road/Erickson Avenue is an existing six phase, signalized intersection at the southern end of the study area. The mainline left turn lanes on US 11 are currently phased as permitted/protected left turns utilizing flashing yellow arrows. The side street approaches on Mosby Road currently operate under split phasing. An aerial image of the existing geometry at the intersection is shown in **Figure 4**.

Figure 4: Existing Geometry at the Intersection of US 11 and Mosby Road

Synchro analysis results for the existing PM peak hour are shown below in **Table 2**.

Table 2: Existing PM Analysis Results for US 11 and Mosby Road

PM Peak Hour Delay, LOS, and Queue Summary for					
			2019 Existing Configuration		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (Route 11) and Mosby Road	South Main Street	NBL	23.0	C	70
		NBTR	35.1	D	682
	South Main Street	SBL	24.0	C	12
		SBTR	31.2	C	593
	Mosby Road	EBL	107.5	F	541
		EBTR	50.3	D	0
	Mosby Road	WBLTR	75.9	E	63
	Overall		44.0	D	-

The eastbound left turn volume causes a significant amount of delay on that approach in existing conditions. In addition, due to the split phasing and the high amount of split necessary to accommodate the eastbound lefts, the mainline movements also experience a heavy amount of delay. The westbound movements show high delay in existing conditions as well; this is somewhat mitigated by the low number of vehicles utilizing those movements.

2.1.3 US 11 Commercial Access Segment

The portion of US 11 between the two study intersections is classified as a minor arterial with a speed limit of 35 miles per hour (MPH). An aerial image of the existing geometry on the corridor is shown in **Figure 5**.

Figure 5: Existing Geometry on US 11 within the Study Area

The cross-section consists of two through lanes in each direction and a center two-way left turn lane. The two-way left turn lane provides access to seven full-access driveways to and from Dukes Plaza on the west side of US 11. It also provides access to two single-family homes and a business on the east side of US 11, though these movements are minor compared to the ingress/egress movements for Dukes Plaza. Additionally, there are two bus stops for Harrisonburg Department of Public Transportation (HDPT) busses on this portion of US 11.

2.1.4 Erickson Avenue and Pear Street

The intersection of Erickson Avenue and Pear Street is an existing unsignalized intersection located approximately one mile west of the intersection of US 11 and Stone Spring Road/Erickson Avenue. An aerial image of the existing geometry at the intersection is shown in **Figure 6**.

Figure 6: Existing Geometry at the Intersection of Erickson Avenue and Pear Street

The eastbound left turn lane has approximately 45’ of effective storage length. This is due to the fact that there is a railroad crossing approximately 120’ to the west of the intersection, which limits the amount of space available for expansion of the turn lane facilities on the western approach.

Synchro analysis results for the existing PM peak hour are shown below in **Table 3**.

Table 3: Existing PM Analysis Results for Erickson Avenue and Pear Street

PM Peak Hour Delay, LOS, and Queue Summary					
			2017 Existing Configuration		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
Erickson Avenue and Pear Street	Erickson Avenue	EBL	9.9	A	6
		EBTR	0.0	A	0
	Erickson Avenue	WBL	9.4	A	0
		WBTR	0.0	A	0
	Pear Street	NBLTR	297.2	F	174
	Pear Street	SBLTR	29.8	D	30
	Overall		19.7	C	-

Mainline movements on Erickson Avenue operate at free flow conditions. As a result, the northbound movements are unable to find gaps in the mainline traffic. The single lane nature of the approach limits the number of northbound right turning vehicles that may have otherwise been able to find a gap in the traffic on the eastbound mainline approach.

2.2 Existing Safety Conditions

2.2.1 Study Area Safety Conditions

For safety analysis, the VDOT Crash Database Tableau Tool was utilized to determine the crash history at the two study intersections and on the roadway between them. Crash data was collected and analyzed for a five-year period spanning from 2013 to 2018. The study team analyzed the available data to determine specific trends and "hot spot" areas for consideration in developing alternative improvement concepts. As part of the crash data review, all crashes were mapped by crash type and severity. For the purposes of this analysis, total injury crashes is defined as the sum of type A (severe injury), B (visible injury), and C (non-visible injury) crashes.

Figure 7 shows an aerial map of the crash analysis zones selected within the study area. **Table 4** summarizes the crashes at each location.

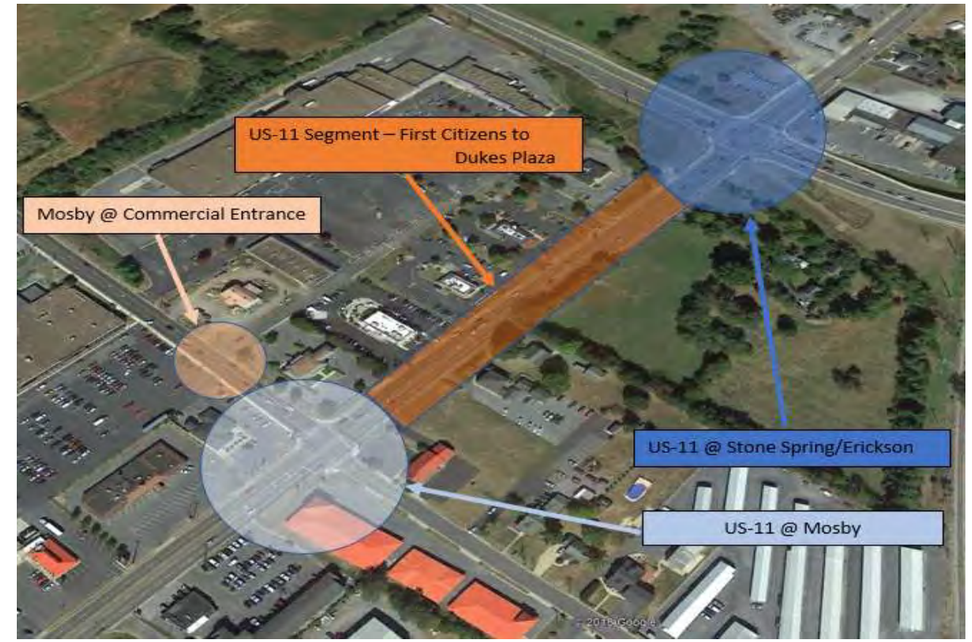


Figure 7: Crash Analysis Zones

Table 4: Study Area Crash Severity Summarized by Location

Study Area Crash Severity Summarized By Location						
Location	Total	K	A	B	C	PDO
US 11 and Stone Spring Road/Erickson Avenue	47	0	0	7	1	37
US 11 and Mosby Road	32	0	0	6	2	24
US 11 Commercial Access Segment	59	0	0	8	0	51
Mosby Road and Dukes Plaza Access	19	0	0	3	1	15
Total in Study Area	157	0	0	24	4	127

The most significant concentration of crashes occurs on the commercial access segment of US 11. There are also a high number of crashes at the signals.

Table 5 and **Figure 8** provide a summary of the crashes at the intersection of US 11 and Stone Spring Road/Erickson Avenue. **Figure 9** provides an aerial crash diagram for the intersection.

Table 5: US 11 and Stone Spring Road/Erickson Avenue Crash Type Summary

US 11 and Stone Spring Road/Erickson Avenue Crash Type Summary				
Crash Type	Total	B	C	PDO
Angle	19	6	1	12
Rear-end	20	1	0	19
Sideswipe	6	0	0	6
Deer	2	0	0	0
Total at Intersection	47	7	1	37

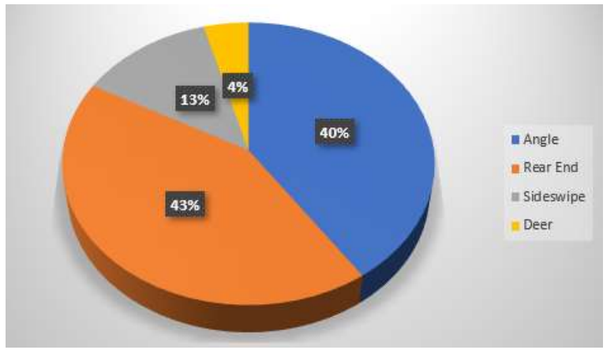


Figure 8: US 11 and Stone Spring Road/Erickson Avenue Crash Type Breakdown

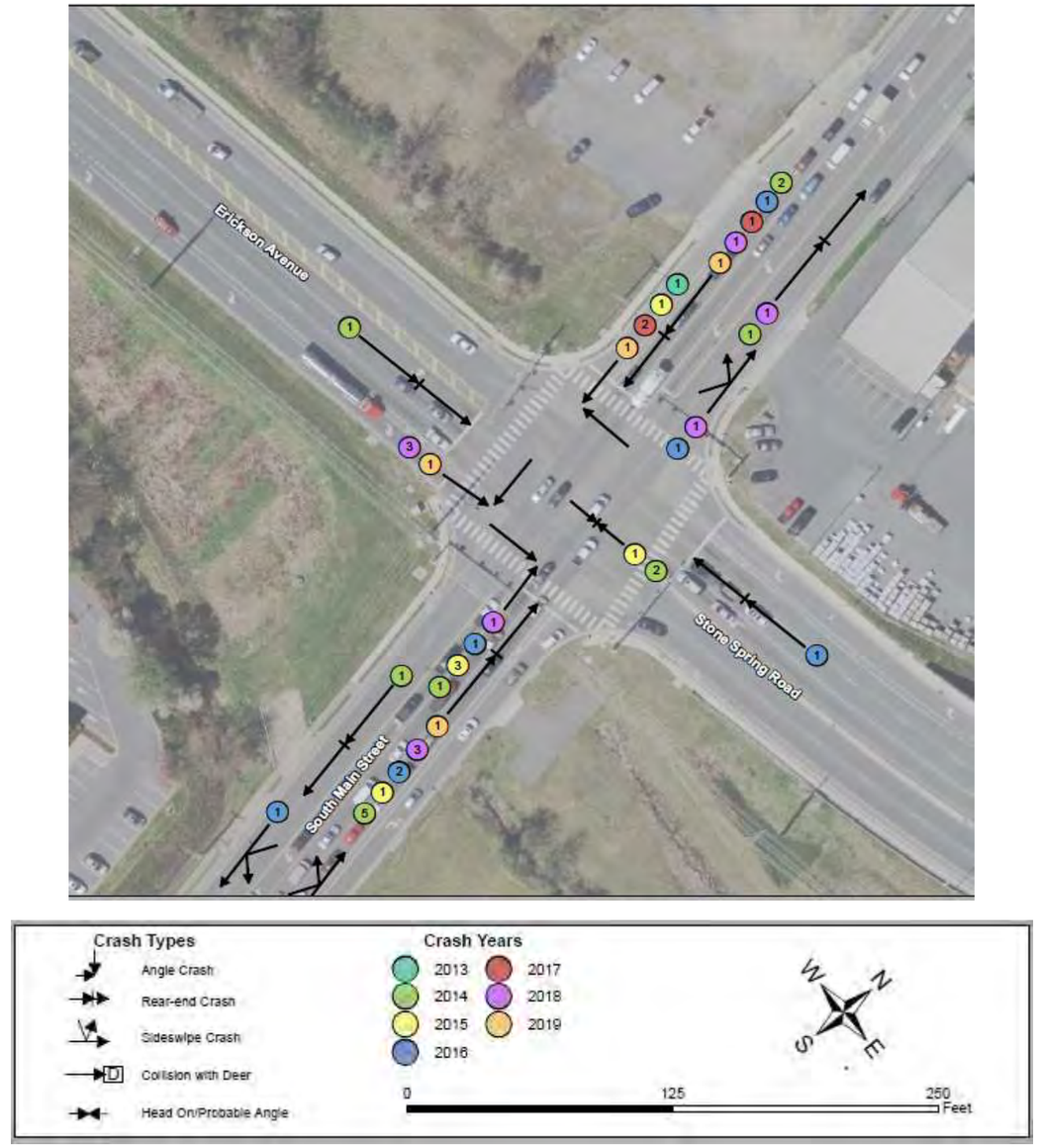


Figure 9: US 11 and Stone Spring Road/Erickson Avenue Crash Diagram

The majority of the crashes at the intersection are angle and rear-end crashes. Approximately 17% of the crashes resulted in an injury. There are a number of sideswipe crashes in the same direction in the vicinity of the signal, likely due to lane changes.

Table 6 and **Figure 10** below provide a summary of the crashes at the intersection of US 11 and Mosby Road. **Figure 11** displays an aerial crash diagram for the intersection.

Table 6: US 11 and Mosby Road Crash Type Summary

US 11 and Mosby Road Crash Type Summary				
Crash Type	Total	B	C	PDO
Angle	14	3	1	10
Rear-End	15	3	1	11
Sideswipe	2	0	0	2
Deer	1	0	0	1
Total at Intersection	32	6	2	24

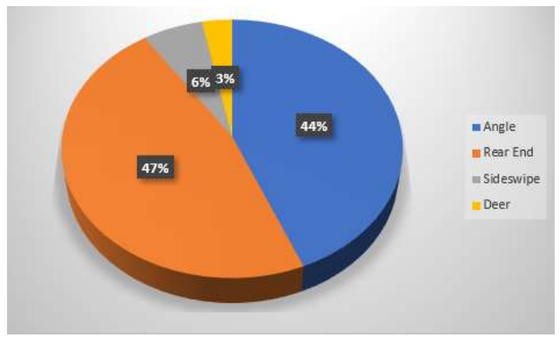


Figure 10: US 11 and Mosby Road Crash Type Breakdown

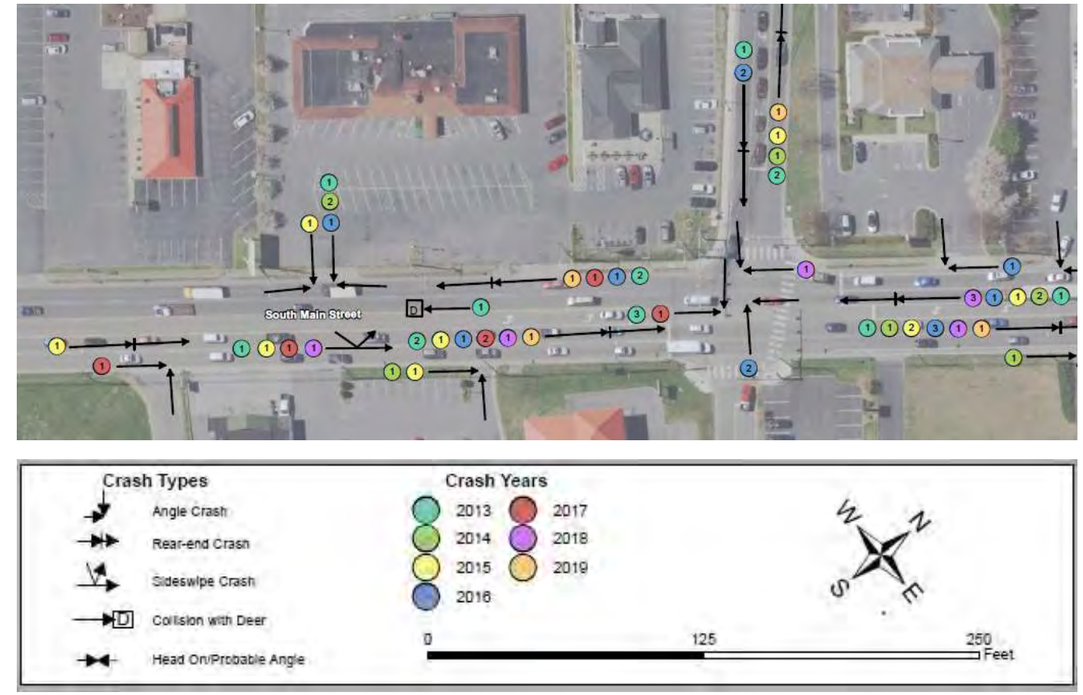


Figure 11: US 11 and Mosby Road Crash Diagram

Similar to the intersection of US 11 and Stone Spring Road/Erickson Avenue, the intersection of US 11 and Mosby Road experiences a high percentage of angle and rear end crashes with a minor number of sideswipe crashes in the same direction of travel. Though this intersection has a lower number of crashes than the intersection of US 11 and Stone Spring Road/Erickson Avenue, as well as the US 11 commercial access segment, it has the same number of injury crashes over the study period. Of the reported crashes, 20% were recorded as injury crashes.

Table 8 and **Figure 12** summarize the crashes on the US 11 commercial access segment. **Figure 13** displays an aerial crash diagram for that portion of US 11.

Table 7: US 11 Commercial Access Segment Crash Type Summary

US 11 Commercial Access Segment				
Crash Type	Total	B	C	PDO
Angle	22	4	0	18
Rear-End	30	2	0	28
Sideswipe	7	2	0	5
Total at Intersection	59	8	0	51

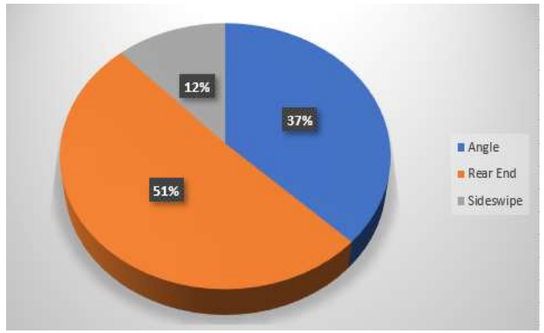


Figure 12: US 11 Commercial Access Segment Crash Type Breakdown

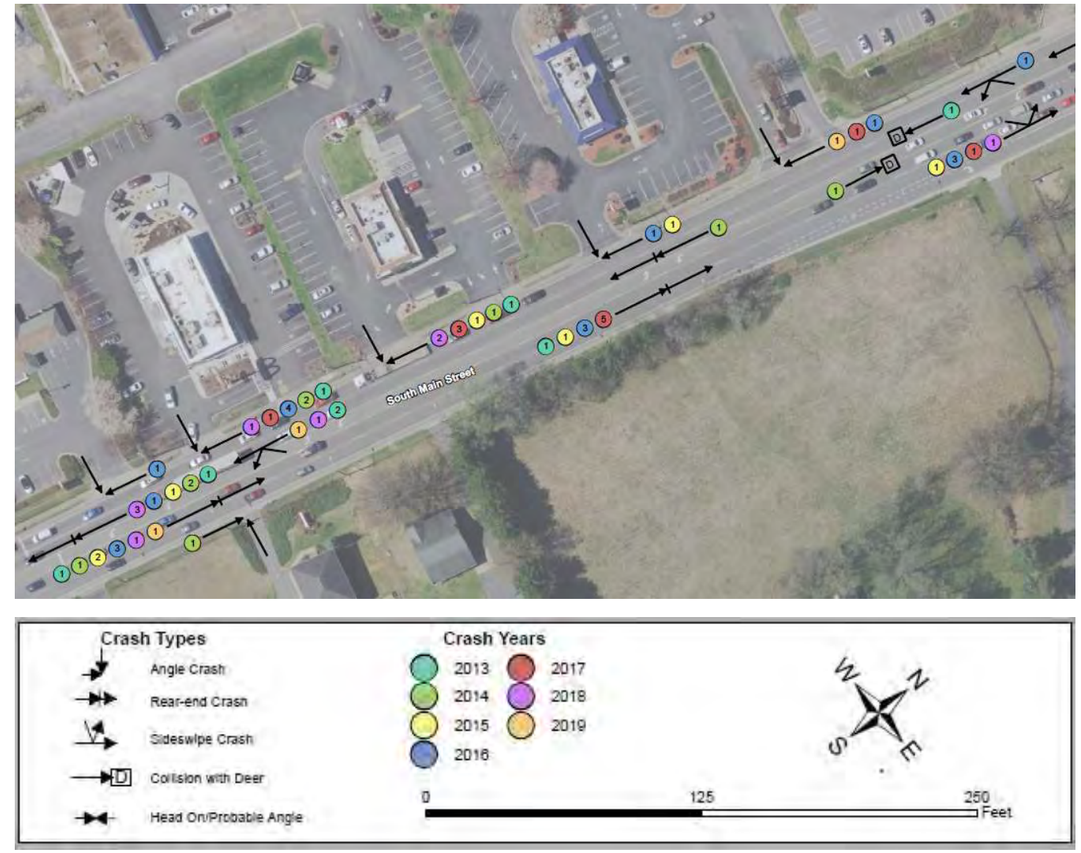


Figure 13: US 11 Commercial Access Segment Crash Diagram

There is a high concentration of angle crashes, primarily due to the commercial access driveways, and rear end crashes, primarily due to the congestion through this portion of the corridor as a result of the signals at both ends. There are also a minor number of sideswipe crashes on this section of US 11. This study area recorded the lowest percentage of injury crashes, with approximately 14% of the reported crashes being reported with injuries.

Table 8 and **Figure 14** below show a summary of the crash breakdown at the Mosby Road entrance to Dukes Plaza. **Figure 15** shows an aerial crash diagram for the crashes at the intersection.

Table 8: Mosby Road and Dukes Plaza Access Crash Type Summary

Mosby Road and Dukes Plaza Access				
Crash Type	Total	B	C	PDO
Angle	14	2	1	11
Rear-End	4	1	0	3
Backed Into	1	0	0	1
Total at Intersection	19	3	1	15

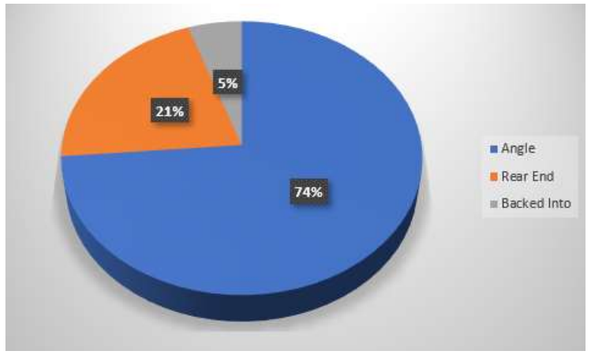


Figure 14: Mosby Road and Dukes Plaza Access Crash Type Breakdown

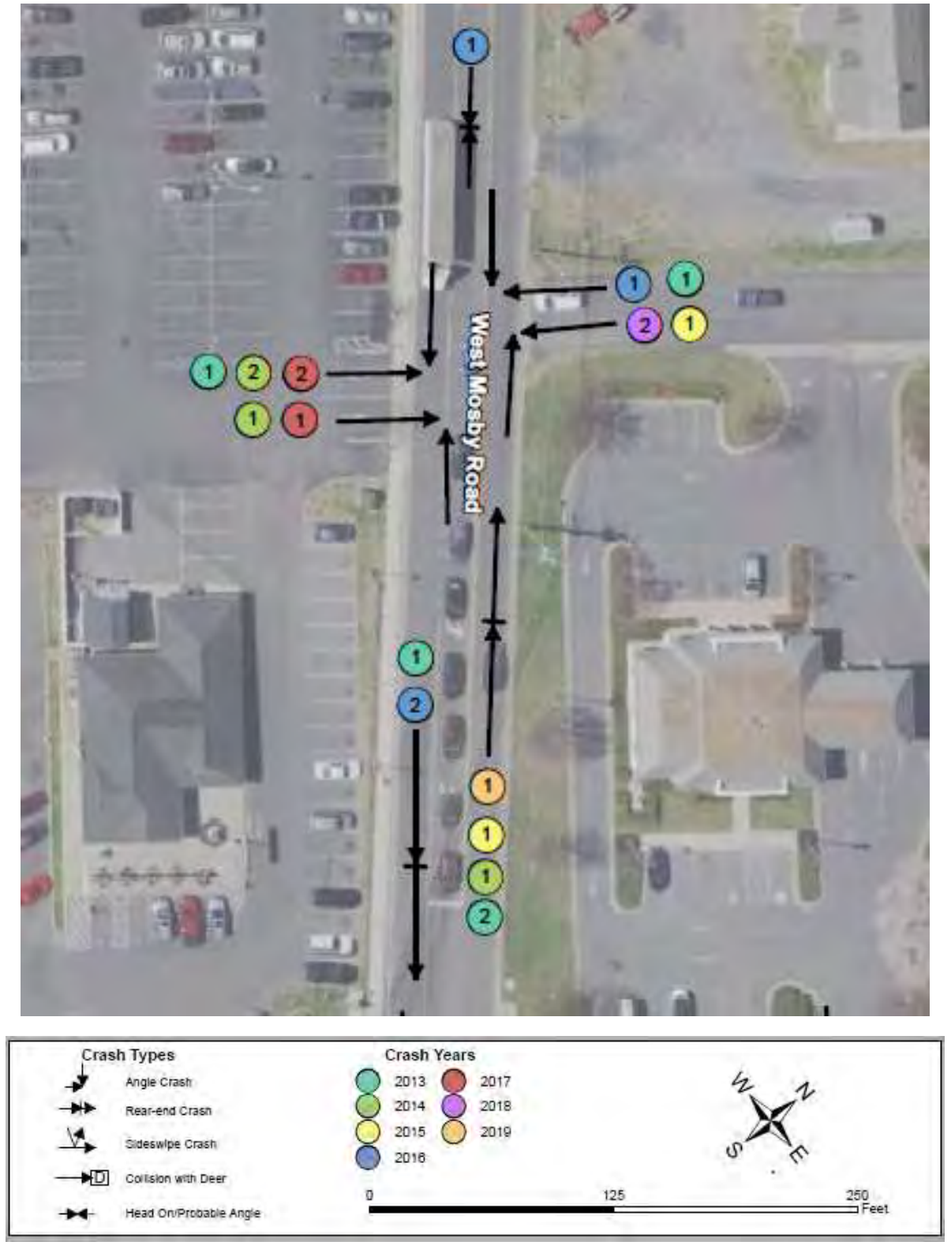


Figure 15: Mosby Road and Dukes Plaza Access Point Crash Diagram

Though this intersection has the fewest total number of crashes within the study area, it has the highest number of injury crashes. 21% of the reported crashes at the intersection were recorded as injury crashes. The majority of the crashes at this intersection are angle crashes associated with movements into and out of the Dukes Plaza entrance as well as the commercial driveway on the opposite side of Mosby Road.

From 2014 through October 2019, there were 29 reported crashes at the intersection of Erickson Avenue and Pear Street. 7 of these crashes resulted in visible (Type B) injuries, 6 of which were angle collisions and one was a rear-end. The remaining 22 crashes resulted in Property Damage Only, of which 18 were angle collisions, 2 were rear-ends, 1 was head-on, and 1 was a run off the road. None of the crashes were alcohol-related. 5 crashes involved a driver admitting to being distracted, and 3 crashes were reported with speeding as a contributing factor. 26 of 29 crashes occurred in dry conditions, with 28 of 29 crashes taking place under clear weather conditions. 24 of 29 crashes occurred during daylight hours.

As the majority of crashes at the intersections are related to congestion and permissive left turns, these areas were considered the focus for safety upgrades at the signals. For the commercial access segment, priority was given to the reduction of crashes due to the two-way left turn lane and the commercial access driveways.

2.3 Existing Access Spacing

Currently, there are seven commercial access driveways on US 11 used for access to Dukes Plaza. An aerial of these driveways and the spacing between them, as well as the two adjacent intersections, is shown in **Figure 16**.

Figure 16: Existing Commercial Access Spacing

None of these driveways currently meet VDOT access spacing standards for space between two full access driveways. Additionally, the two driveways closest to the signals at Stone Spring Road/Erickson Avenue and Mosby Road do not meet access spacing standards for the distance between a signalized intersection and a full access driveway. VDOT access spacing standards for a minor arterial are shown in **Table 9**.

Table 9: VDOT Access Spacing Standards for Minor Arterials

Highway Functional Classification	Legal Speed Limit (mph)①	Minimum Centerline to Centerline Spacing (Distance) in Feet			
		Spacing from Signalized Intersections to Other Signalized Intersections ②	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections& Full Median Crossovers ③	Spacing from Full Access Entrances or Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover ④	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover ⑤
Minor Arterial	< 30 mph	880	660	355	200
	35 to 45 mph	1,050	660	470	250
	≥ 50 mph	1,320	1,050	555	425

2.4 Public Involvement Part 1 / Survey Results

Phase 1 of public involvement was conducted between August 19, 2019 and September 12, 2019. For the full duration of this time period, an online survey was open to allow the public a chance to give their feedback on the congestion and safety issues within the study area. The survey closed with 222 participants. Survey participants were asked a series of questions to determine the relevant demographics of travelers, the issues they see within the study area, and reaction to potential improvements.

Key takeaways from the first public involvement survey results are as follows:

- The majority of the respondents using the corridor are either through commuters or customers or employees of the businesses of the study area.
- The vast majority of the respondents use passenger vehicles. A minimal number of respondents use public transportation or are pedestrians/bicyclists within the study area.
- The main study area, as well as the intersection of Erickson Avenue and Pear street, is considered to be in need of improvements by the majority of respondents.
- Congestion, safety issues, access management, and pedestrian/bicycle safety were major areas of concern for a high number of respondents.
- Generally, respondents are in favor of access management improvements or alternative intersection designs that may increase their travel time. This is caveated by the fact that some respondents will only accept these alternatives if there is a noticeable improvement to safety and congestion.

Survey participants were also offered the opportunity to give open responses to the improvements they would most like to be implemented. 104 open responses were given out of the 222 full survey participants. Results are summarized as follows:

- 30 suggestions were given for US 11. Answers generally suggested geometric improvements/widening the approaches to the signals. There was support for access management on US 11.
- 38 suggestions were given for the intersection of Erickson Avenue and Pear Street. Responses were favorable towards installing a signal or other geometric improvements/restrictions at the intersection, as well as access management improvements on Erickson Avenue.

- 24 suggestions were related to pedestrian and bike issues. These answers corresponded with bike lane/sidewalk/crossing improvements.
- 22 suggestions were made for other issues not included in the scope of this study, including the installation of signals or other improvements to various nearby intersections and corridors, development restrictions, public transportation improvements.

3.0 Improvement Alternatives

3.1 Summary and Development of Alternatives

In developing alternative scenarios, a thorough review of the existing conditions data and results of the public survey were considered. The goal of the study team was to develop multiple options that would address the highest priority concerns for further consideration and feedback. Options were developed at different levels of construction and implementation cost for each of the signalized intersection locations. The goal of each option was to find new or innovative ways to improve the efficiency of the signals and corridor through application of multiple approaches including:

- Simplification or reduction of signal phases
- Minor operational improvements or geometrics to expand capacity
- Alternative or Innovative Intersections
- Access management improvements

After a review of multiple options at each intersection, the study team developed several alternative scenarios for further analysis and subsequent concept development. These scenarios were carried forward to solicit public input. Those scenarios, grouped by location, are summarized as follows:

3.1.1 Intersection of US 11 and Stone Spring Road/Erickson Avenue

- Alternative 1 – Conventional Intersection Upgrades on US 11
- Alternative 2A – Quadrant Roadway Intersection
- Alternative 2B – Quadrant Roadway Intersection with Drop Lane Approaches

3.1.2 Intersection of US 11 and Mosby Road

- Alternative 3 – Re-Phasing of Mosby Road
- Alternative 4 – Widening of Mosby Road

3.1.3 US 11 Commercial Access Portion

- Alternative 5 – Median and Sidewalk on US 11

3.1.4 Intersection of Erickson Avenue and Pear Street

- Alternative 6 – Signalization
- Alternative 7 – Reduced Conflict Intersection

Concepts will be henceforth referred to as “Alternative #”. Alternatives are discussed in greater detail in the sections that follow.

3.2 Discussion of US 11 and Stone Spring Road/Erickson Avenue

3.2.1 Alternative 1 – Conventional Intersection Upgrades on US 11

This alternative explores the effects of adding a second left turn lane to the northbound and southbound approaches on US 11 to provide for additional left turn capacity. This change will necessitate modifying the existing left turn signal phasing from protected/permitted with flashing yellow arrows to protected only phasing.

A concept sketch of Alternative 1 is shown in **Figure 17**.

Figure 17: Alternative 1 Concept Sketch

3.2.2 Alternative 2A – Quadrant Roadway Intersection

This alternative would add a quadrant roadway to the northwestern quadrant of the intersection, remove all left turns at the Stone Spring intersection, and re-route them through the quadrant roadway at two new signalized intersections north and west of the existing intersection. For the purposes of these analysis scenarios, the quadrant roadway intersections were located 600’ north and 500’ west of the Stone Spring intersection. These locations were chosen due to being perceived as the ideal tie-in locations for operations and geometric considerations.

The proposed quadrant roadway egress consisted of a left turn lane and a right turn lane and the ingress consists of from Main Street and Erickson Avenue. These signals would operate with a permitted/protected left turn into the quadrant roadway. The right turns for the egress from the quadrant roadway were allowed to operate as a

right turn overlap with the mainline left turns into the quadrant roadway. The removal of left turns at the intersection would present an opportunity for a reduction in the number of angle crashes at the intersection.

A concept sketch of Alternative 2A is shown in **Figure 18**.

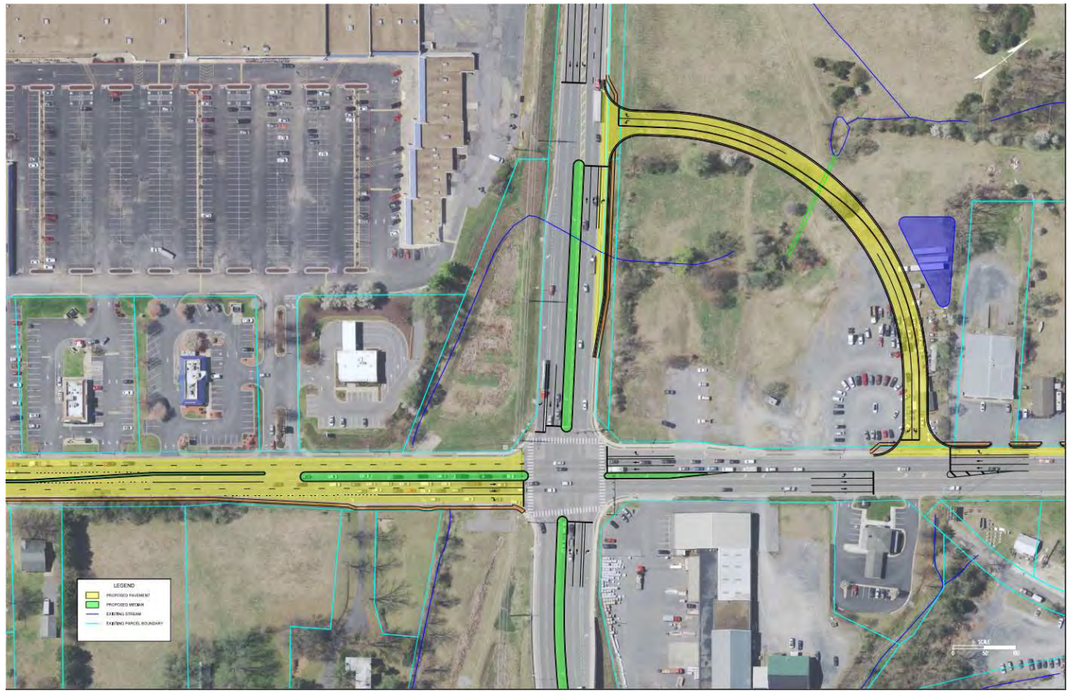


Figure 18: Alternative 2A Concept Sketch

3.2.3 Alternative 2B – Quadrant Roadway Intersection with Drop Lane Approaches

This alternative would use Alternative 2A as a base but would repurpose the existing pavement for the northbound and westbound left turns at the Stone Spring intersection. The northbound left turn lane would be repurposed as a through lane which would tie directly into the northbound left turn lane at the quadrant roadway intersection as a drop lane. The westbound left turn lane would be repurposed into a through lane that would tie into the innermost westbound through lane on the western side of the Stone Spring intersection. The outermost westbound through lane on the eastern side of the Stone Spring intersection would then tie into the westbound right turn lane at the western quadrant roadway intersection as a drop lane.

A concept sketch of Alternative 2B is shown in **Figure 19**.

Figure 19: Alternative 2B Concept Sketch

3.3 Discussion of US 11 and Mosby Road

3.3.1 Alternative 3 – Re-Phasing of Mosby Road

This alternative proposes to alter the phasing at Mosby Road to concurrent side street operations. Currently, the signal at Mosby Road operates with split phasing for the side streets. The amount of westbound traffic at the signal is low and the time dedicated for the westbound phase causes significant delay on US 11. It was noted during field observations in the PM peak hour that the westbound signal phase would activate for only a single vehicle nearly every cycle. Due to the low number of potential conflicts for the eastbound lefts, more cycle time may be dedicated to the through movements on US 11. A lagging protected left turn phase utilizing a flashing yellow arrow is recommended for the eastbound approach due to the high volume of left turning vehicles.

Additionally, the existing signalized pedestrian crossing on the northern leg of the intersection is proposed to be moved to the southern leg to better accommodate the heavy eastbound left turns. It also recommended that the sidewalk on the eastern side of the intersection be expanded to connect to the bus stops on US 11 in the vicinity of Mosby Road as part of any pedestrian upgrades made to the intersection.

3.3.2 Alternative 4 – Widening of Mosby Road

This alternative consists of adding an additional left turn lane to the eastbound approach at the intersection. The existing split phasing at the intersection would remain to accommodate the dual eastbound left turn lane.

Additionally, the modifications to the pedestrian accommodations outlined in Alternative 3 are similarly recommended for Alternative 4.

A concept sketch of Alternative 4 is shown in **Figure 20**.

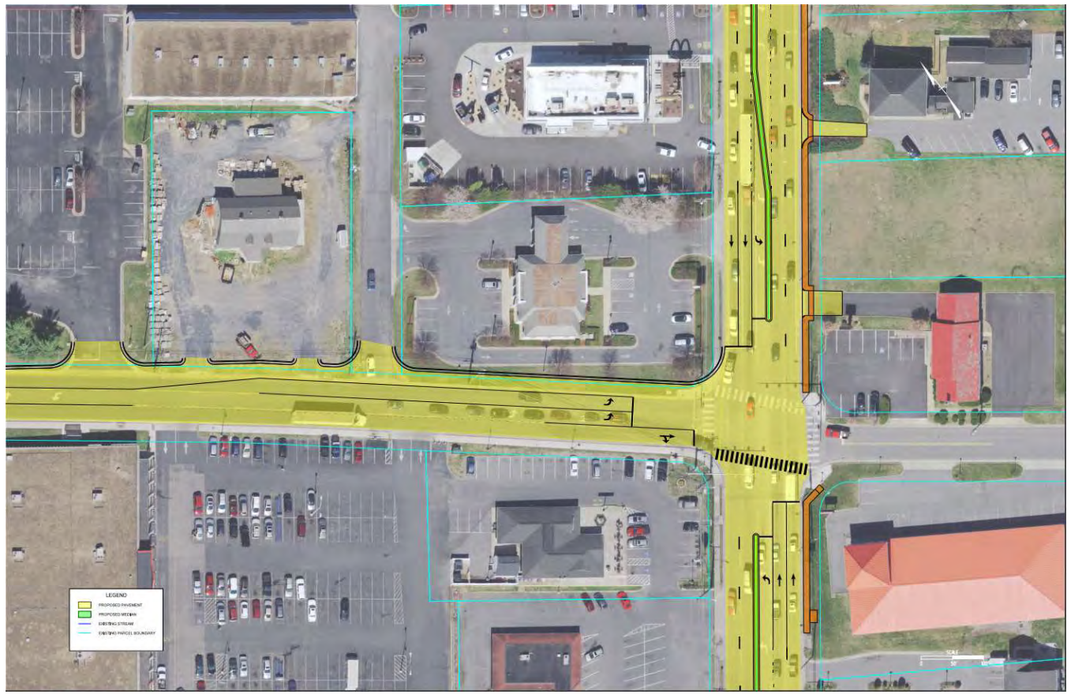


Figure 20: Alternative 4 Concept Sketch

3.4 Discussion of US 11 Commercial Access Portion

3.4.1 Alternative 5 – Commercial Access Management Improvements on US 11

As mentioned in the Existing Safety Conditions of this report, the existing two-way left turn lane and high number of commercial access driveways on the west side of Main Street present a safety issue due to their correlation with angle crashes. To improve safety on this portion of the corridor, it is proposed that the two-way left turn lane be replaced with a raised median and the majority of the commercial access driveways be restricted to right-in/right-out movements. To minimize impacts to the businesses, the existing main entrance to and from Dukes Plaza would remain a full access driveway. The change to right-in/right-out access for the majority of the driveways represents a 60% crash reduction as per SmartScale crash mitigation factors. Also as part of this alternative, a new sidewalk is proposed on the eastern side of US 11 within the study area.

Access at the main entrance to Dukes Plaza was evaluated for three scenarios: right-in/right-out only, a restriction on only lefts out, and full access. The decision was made to accommodate full access at the driveway to best provide reasonable access to the businesses within the development. Additionally, a full restriction of left turns into and out of Dukes Plaza on US 11 would result in a consolidation of traffic at the Mosby Road signal. This was considered unideal due to the existing crash pattern involving left turns within the functional area of the Mosby Road intersection.

To best accommodate the modifications proposed in this alternative, the existing bike lanes within this section of the corridor would be removed. The existing bike lanes only meet minimum geometric standards and provide a minimal level of user comfort due to their narrow width and high traffic volumes. The study team and several stakeholders, including the Harrisonburg Transportation Safety and Advisory Commission, were supportive of the removal of the bike lanes as a means to increase cost competitiveness of this alternative. The proposed addition of sidewalk on the eastern side of US 11 would serve as an off-street bike and pedestrian alternative.

A concept sketch of Alternative 5 is shown in **Figure 21**.

Figure 21: Alternative 5 Concept Sketch

A memo outlining the analysis process as a memo outlining the design considerations and cost estimate for Alternative 5 can be found in the Appendix.

3.5 Discussion of Erickson Avenue and Pear Street

3.5.1 Alternative 6 – Signalization

This alternative would add a full color traffic signal to the existing unsignalized intersection. The signalization of this intersection was recommended by the Wenger-Burkholder Residential Development TIA.

3.5.2 Alternative 7 – Reduced Conflict Intersection

This alternative would add a Reduced Conflict Intersection east of the intersection to service the northbound left and through traffic from Pear Street as well as the eastbound left turns from Erickson Avenue. Southbound Pear Street left and through traffic would be serviced as U-turns at the existing downstream signal at Erickson Avenue and High Street. It is proposed that this median U-turn will be signalized with protected-only phasing due to limited sight distance at the proposed intersection location. VDOT Traffic Engineering will develop a Signal Justification Report to evaluate this conclusion and officially document a recommended treatment.

This alternative was initially developed as part of the Wenger-Burkholder Residential Development TIA. The TIA found that the 8-hour, 4-hour, peak hour, and crash MUTCD signal warrants are met at the intersection under existing (2017) conditions. Existing left turn delay on northbound Pear Street is over 200 seconds. That delay is expected to rise to over 300 seconds in the future year 2027 with the addition of the nearby development.

Several treatment alternatives were assessed at the intersection. A roundabout was deemed infeasible because of the intersection's close proximity to the railroad tracks and the adjacent signal at Route 42 and Erickson Avenue. The Reduced Conflict Intersection outlined in this alternative was qualitatively eliminated by the TIA because of the high perceived cost within the context of a potential developer-led mitigation strategy.

Signalization of the intersection was found to reduce delay, but simulation found that future year queueing would fill the eastbound and westbound block between the Route 42 and Pear Street signals on Erickson Avenue. Despite these operational limitations, the signal was recommended by the TIA. Recognizing the limitations of the signalization option, the city requested a quantitative analysis of the Reduced Conflict Intersection alternative.

A concept sketch of Alternative 7 is shown in **Figure 22**.

Figure 22: Alternative 7 Concept Sketch

4.0 Future Traffic Forecasting and Modeling

4.1 Traffic Forecasting and Methodology

Traffic forecasting for the 2028 future year on the study corridor was taken directly from the Harrisonburg High School Traffic Impact Analysis. Forecasting for the Erickson Avenue design work 2027 future year was taken directly from the 2017 Wenger-Burkholder Residential Development Traffic Impact Analysis. An aerial map showing the intersections and their existing turning movement counts is shown below in Figure 23.

Figure 23: Study Intersections Future Year Turning Movement Counts

Several assumptions were made as part of the Harrisonburg High School TIA to grow the 2019 existing volumes to the 2028 future year. A 1% background growth rate was applied to the existing volumes for each year from 2019 to 2028. It was noted in the TIA that this likely represents a conservative growth rate, as VDOT traffic counts in the region show a zero or negative growth rate over the past ten years.

Future models assume a full occupancy of the proposed 1,200 student school. The models also incorporate traffic from nearby developments with full build out expected by the year 2028, including:

- Cobbler's Valley residential development
- Bluestone Development mixed-use development
- U-Haul truck rental center

As part of the Harrisonburg High School TIA, the PM cycle length at both study intersections on US 11 was increased from 140 seconds to 190 seconds to better accommodate the traffic growth. This cycle length as well as the optimized splits and offsets were used as the basis for the No-Build model for this study.

Signal timings for the Build scenarios were further optimized to best accommodate the proposed modifications. Through optimization, it was found that a cycle length of 150 seconds was ideal for all of the proposed alternatives. Build model splits and offsets were optimized within the 150 second cycle length for each alternative.

The signal at the intersection of Erickson Avenue and Pear Street proposed in Alternative 6 was analyzed with a 120 second cycle length in the Wenger-Burkholder Residential Development TIA. The new signal was coordinated with the adjacent intersection at South High Street and Erickson Avenue.

4.2 Future Traffic Model Results

4.2.1 Future Model Results for US 11 and Stone Spring Road/Erickson Avenue

The proposed alternatives tested in this analysis are as follows:

- Alternative 1 – Conventional Intersection Upgrades on US 11
- Alternative 2A – Quadrant Roadway Intersection
- Alternative 2B – Quadrant Roadway Intersection with Drop Lane Approaches

The first scenarios analyzed were the existing configuration and Alternative 1 using 2028 volumes to compare to the existing intersection results. A summary of these results as compared to the existing 2018 results is shown below in **Table 10**.

Table 10: 2019 and 2028 PM Peak Hour Analysis Results for Existing Configuration and Alternative 1 at US 11 and Stone Spring Road

PM Peak Hour Delay, LOS, and Queue Summary											
			2019 Existing Configuration			2028 No-Build			2028 Alternative 1		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Stone Spring Road/Erickson Avenue	South Main Street	NBL	26.6	C	281	71.8	E	828	45.0	D	304
		NBT	29.2	C	315	56.4	E	644	16.9	B	354
		NBR	19.4	B	96	28.1	C	376	12.3	B	103
	South Main Street	SBL	35.8	D	287	132.2	F	441	82.3	F	192
		SBT	38.8	D	341	64.5	E	572	49.7	D	406
		SBR	28.5	C	45	47.4	D	16	12.5	B	41
	Erickson Avenue	EBL	40.3	D	81	45.6	D	141	45.1	D	119
		EBT	65.8	E	264	81.9	F	375	62.8	E	283
		EBR	43.5	D	79	48.8	D	201	14.2	B	98
	Stone Spring Road	WBL	57.1	E	296	71.7	E	638	197.8	F	576
		WBT	48.3	D	265	54.3	D	351	54.3	D	305
		WBR	37.2	D	110	44.8	D	156	43.1	D	105
	Overall		44.0	D	-	61.8	E	-	51.6	D	-

Compared to the 2019 existing results, the intersection's performance will degrade by 2028 if the intersection's geometric configuration is left as-is, even with re-timing of the signal. Adding a second left turn lane to the northbound and southbound movements in Alternative 1 will improve overall intersection LOS from an E to a D, but many movements will remain with poor levels of service.

A comparison between the 2028 existing configuration results and the results of Alternatives 2 and 2B can be seen below in **Table 11**.

Table 11: 2028 PM Peak Hour Analysis Results for Existing Configuration and Alternatives 2A and 2B at US 11 and Stone Spring Road

PM Peak Hour Delay, LOS, and Queue Summary											
			2028 No-Build			2028 Alternative 2A			2028 Alternative 2B		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Stone Spring Road/Erickson Avenue	South Main Street	NBL	71.8	E	828	N/A			N/A		
		NBT	56.4	E	644	0.4	A	93	12.4	B	116
		NBR	28.1	C	376	0.6	A	25	13.6	B	110
	South Main Street	SBL	132.2	F	441	N/A			N/A		
		SBT	64.5	E	572	17.8	B	210	13.8	B	484
		SBR	47.4	D	16	13.2	B	32	10.2	B	94
	Erickson Avenue	EBL	45.6	D	141	N/A			N/A		
		EBT	81.9	F	375	48.5	D	288	56.7	E	326
		EBR	48.8	D	201	47.1	D	177	54.6	D	176
	Stone Spring Road	WBL	71.7	E	638	N/A			N/A		
		WBT	54.3	D	351	53.3	D	520	53.0	D	342
		WBR	44.8	D	156	45.0	D	226	51.6	D	242
	Overall		61.8	E	-	25.1	C	-	30.2	C	-
South Main Street (US 11) and Quadrant Roadway	South Main Street	NBL	N/A			28.6	C	365	27.7	C	121
		NBT				4.3	A	23	6.9	A	47
	South Main Street	SBT				39.6	D	433	16.8	B	416
		SBR				25.8	C	40	6.7	A	37
	Quadrant Roadway	EBL				74.8	E	145	61.4	E	142
		EBR				28.0	C	227	91.9	F	10
	Overall					24.3	C	-	25.1	C	-
Erickson Avenue and Quadrant Roadway	Erickson Avenue	EBL	N/A			21.8	C	65	21.8	C	65
		EBT				6.7	A	196	6.7	A	196
	Erickson Avenue	WBT				42.2	D	415	42.5	D	48
		WBR				25.9	C	0	26.3	C	111
	Quadrant Roadway	SBL				69.1	E	262	69.1	E	315
		SBR				24.9	C	275	24.9	C	163
	Overall					28.3	C	-	28.4	C	-

Compared to the existing configuration, both Alternatives 2A and 2B are expected to improve LOS at the main intersection from LOS E to LOS C. The new geometry and timing allow for a significant reduction in delay for the mainline through movements, greatly improving mobility through the US 11 corridor.

It was noted during the review of the results that the westbound through queue approaching the quadrant roadway intersection on Erickson Avenue utilizes the full length of storage available at the proposed location in Alternative 2A. This may cause the queues to spill back from the quadrant intersection into the intersection at US 11 and Stone Spring Road/Erickson Avenue.

Alternative 2A is considered the preferred option because it provides the same operational benefit as Alternative 2B while also being less likely to cause less confusion for drivers and more likely to discourage illegal left turns at the main intersection.

4.2.2 Future Model Results for US 11 and Mosby Road

The proposed alternatives tested in this analysis are as follows:

- Alternative 3 – Re-Phasing of Mosby Road
- Alternative 4 – Widening of Mosby Road

Because Alternative 3 only requires changes to the signal phasing and heads, Alternative 3 was analyzed with 2019 volumes to quantify the benefits to the intersection if that alternative was implemented at the present time. The results of this analysis and a comparison to the existing intersection are shown below in **Table 12**. For the purposes of this analysis, Alternative 3 was analyzed using the existing PM peak hour cycle length of 146 seconds with optimized splits and offset.

Table 12: 2019 PM Peak Hour Analysis Results for Existing Configuration and Alternative 3 at US 11 and Mosby Road

PM Peak Hour Delay, LOS, and Queue Summary								
			2019 Existing Configuration			2019 Alternative 3		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Mosby Road	South Main Street	NBL	23.0	C	70	19.7	B	54
		NBTR	35.1	D	682	29.7	C	515
	South Main Street	SBL	24.0	C	12	20.6	C	12
		SBTR	31.2	C	593	26.5	C	374
	Mosby Road	EBL	107.5	F	541	74.9	E	374
		EBTR	50.3	D	0	40.2	D	0
	Mosby Road	WBLTR	75.9	E	63	89.5	F	78
	Overall		44.0	D	-	38.0	D	-

The results show that removing the split phase at the intersection is likely to provide a short-term benefit to the movements on US 11, with delay being reduced between three to six seconds for each movement. Alternative 3 is also expected to length the lengthy queueing on each approach, potentially reducing the blocking of commercial entrances.

The final analysis comparison was for the existing configuration and Alternatives 3 and 4 in 2028. The results of this analysis can be seen below in **Table 13**.

Table 13: 2028 PM Peak Hour Analysis Results for Existing Configuration and Alternatives 3 and 4 at US 11 and Mosby Road

PM Peak Hour Delay, LOS, and Queue Summary											
			2028 No-Build			2028 Alternative 3			2028 Alternative 4		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Mosby Road	South Main Street	NBL	65.2	E	226	56.9	E	122	50.8	D	109
		NBTR	28.5	C	984	38.0	D	745	40.4	D	758
	South Main Street	SBL	21.4	C	4	43.8	D	6	47.4	D	6
		SBTR	59.7	E	863	45.6	D	346	48.2	D	351
	Mosby Road	EBL	164.9	F	797	79.8	E	477	66.5	E	224
		EBTR	70.8	E	68	43.8	D	53	63.5	E	58
	Mosby Road	WBLTR	100.2	F	111	113.4	F	125	107.2	F	119
	Overall		59.5	E	-	47.7	D	-	48.5	D	-

Both alternatives provide an overall reduction in delay of approximately 11-12 seconds and improve the intersection LOS from an E to a D. Additionally, both are expected to improve the LOS of the eastbound left turn from LOS F to LOS E. The reduction in queueing for the eastbound left will reduce impacts to turning movements at the adjacent commercial entrances on Mosby Road. However, the northbound through/right and southbound left movements will experience a reduction from LOS C to LOS D with implementation of either alternative.

Alternative 3 is considered the preferred option due to the operational benefits it provides compared to both No-Build and Alternative 4, its low cost, and its ability to be implemented in the near-term.

4.2.3 Space Mean Speed on US 11 within the Study Area

In order to provide for an additional measurement of effectiveness of the different alternatives, the northbound and southbound space-mean speeds were extracted from the analysis models for the portion of US 11 within the study area. Space-mean speed represents the average speed of vehicles traveling a defined segment of roadway during a specified period of time and weights slower vehicles' speeds more heavily. Analysis of space-mean speed and the resulting travel times shows which Alternatives provide for the best mobility through the US 11 corridor within the study area.

The space mean speeds are summarized below in **Table 14**.

Table 14: 2028 Space Mean Speed and Travel Time on US 11 within the Study Area

2028 Space Mean Speed and Travel Time on US 11 within the Study Area				
Alternative	NB Speed (MPH)	SB Speed (MPH)	NB TT (Seconds)	SB TT (Seconds)
No-Build	15.7	10.5	53.7	80.3
Alternative 1	21.2	9.8	39.8	86.1
Alternative 2A	26.4	12.7	31.9	66.4
Alternative 2B	26.6	13.4	31.7	62.9
Alternative 3	23.1	15.7	36.5	53.7
Alternative 4	23.2	16.3	36.4	51.7

Compared to the No-Build option and Alternative 1, the quadrant roadway alternatives provide for an improved northbound and southbound speed and travel time on US 11 within the study area. Similarly, Alternatives 3 and 4 provide for an improved northbound and southbound speed and travel time on US 11 compared to No-Build.

4.2.4 Future Model Results for Erickson Avenue and Pear Street

The proposed alternatives tested in this analysis are as follows:

- Alternative 6 – Signalization
- Alternative 7 – Reduced Conflict Intersection

The full analysis results for the existing intersection, No-build, and Alternatives 6 and 7 are shown below in **Table 15**.

Table 15: Analysis Results for Intersection of Erickson Avenue and Pear Street

PM Peak Hour Delay, LOS, and Queue Summary														
			2017 Existing Configuration			2027 No-Build			2027 Build - Alternative 6			2027 Build - Alternative 7		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
Erickson Avenue and Pear Street	Erickson Avenue	EBL	9.9	A	6	10.4	B	8	17.1	B	55	N/A		
		EBTR	0.0	A	0	0.0	A	0	4.7	A	312	0.0	A	0
	Erickson Avenue	WBL	9.4	A	0	11.0	B	10	16.0	B	66	11.7	B	12
		WBTR	0.0	A	0	0.0	A	0	25.3	C	374	0.0	A	0
	Pear Street	NBLTR	297.2	F	174	300+	F	Undefined	78.7	E	297	19.1	C	52
	Pear Street	SBLTR	29.8	D	30	300+	F	Undefined	69.0	E	60	14.4	B	12
	Overall		19.7	C	-	220.9	F	-	22.8	C	-	2.6	A	-
Erickson Avenue R-Cut	Erickson Avenue	EBU	N/A			N/A			N/A			14.6	B	125
		EBT										0.5	A	0
	Erickson Ave.	WBT										5.3	A	156
	Overall											4.4	A	-

Exact analysis results for the 2027 No-Build option for the northbound and southbound movements were unavailable from Synchro as the delay exceeds 300 seconds, which is not compatible with HCM methodologies. Alternative 6 improves overall operations at the intersection compared to the No-Build option in 2027 from LOS F to LOS C. However, the side streets still operate at LOS E and the mainline experiences an increase in delay due to the change from free-flow to signal controlled operation. Additionally, the Wenger Burkholder TIA analysis found that the eastbound and westbound queueing would spill through the block between Route 42 and Pear Street, creating potential operational impacts at each intersection and placing stopped traffic on the railroad tracks. Alternative 7 will improve the overall intersection LOS to LOS A and the side street movements to LOS C for the northbound movements and LOS B for the southbound movements. The mainline through movements continue to operate at LOS A, even with the added signalization for the U-turn.

Alternative 7 is considered the preferred alternative at this intersection due to the significant improvement to delay and potential crash reduction at the intersection.

4.2.5 Future Combined Alternative SimTraffic Results

Because the US 11 alternatives were analyzed on an individual basis in Synchro, a SimTraffic analysis was performed for the No-Build scenario and the combination of the preferred Alternatives 2A and 3. This analysis was performed to show the interaction the preferred alternatives would have with each other and the effects these interactions would have on the study area.

As per TOSAM regulations, ten runs of SimTraffic were performed for each model. Analysis was done for four 15 minute time periods with an hour long seeding period, in which no data was collected. Queues represent the maximum queue length for each lane.

The SimTraffic results for the signalized intersections, analyzed for each lane within the study area, are shown in **Table 16**. Overall network MOEs can be found in **Table 17**.

Table 16: 2028 PM Peak Hour SimTraffic Results for No-Build and Preferred Alternative

PM Peak Hour Delay, LOS, and Queue Summary								
			2028 No-Build			2028 Alternatives 2A + 3		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Stone Spring Road/Erickson Avenue	South Main Street	NBL	73.0	E	200	N/A		
		NBT	416.5	F	1142	21.6	C	377
		NBT	136.4	F	1156	22.4	C	335
		NBR	9.7	A	350	7.3	A	239
	South Main Street	SBL	84.7	F	200	N/A		
		SBT	228.1	F	1105	12.6	B	223
		SBT	193.1	F	1106	13.9	B	242
		SBR	6.6	A	175	6.4	A	166
	Erickson Avenue	EBL	54.6	D	267	N/A		
		EBT	83.5	F	398	35.0	C	324
		EBT	63.5	E	356	29.8	C	318
		EBR	17.1	B	272	12.6	B	211
	Stone Spring Road	WBL	176.1	F	625	N/A		
		WBT	124.9	F	1057	43.1	D	492
		WBT	59.3	E	945	58.4	E	596
		WBR	13.3	B	225	23.4	C	225
	Overall		123.3	F	-	24.9	C	-
South Main Street (US 11) and Mosby Road	South Main Street	NBL	59.9	E	160	54.1	D	159
		NBT	623.9	F	1858	22.5	C	474
		NBTR	298.7	F	1870	21.0	C	459
	South Main Street	SBL	39.9	D	84	31.9	C	83
		SBT	31.1	C	508	24.3	C	416
		SBTR	42.0	D	532	31.6	C	419
	Mosby Road	EBL	64.3	E	155	43.6	D	154
		EBTR	420.7	F	523	154.9	F	508
	Mosby Road	WBLTR	106.6	F	235	76.5	E	172
	Overall		193.1	F	-	33.3	C	-
South Main Street (US 11) and Quadrant Roadway	South Main Street	NBL	N/A			29.0	C	159
		NBT				10.8	B	474
		NBT				4.5	A	459
	South Main Street	SBT				32.8	C	83
		SBT				34.9	C	416
		SBR				8.1	A	419
	Quadrant Roadway	EBL				72.6	E	154
		EBR				26.5	C	508
	Overall					22.0	C	-
Erickson Avenue and Quadrant Roadway	Erickson Avenue	EBL	N/A			24.8	C	163
		EBT				7.2	A	202
		EBT				6.8	A	181
	Erickson Avenue	WBT				9.0	A	97
		WBT				12.9	B	114
		WBR				4.7	A	150
	Quadrant Roadway	SBL				71.5	E	341
		SBR				25.4	C	408
	Overall					17.8	B	-

Table 17: Overall Network MOEs for Study Zone

Network Measures of Effectiveness	2028 No-Build	2028 Alternatives 2B + 4
Overall Network Delay (Hours)	317.4	96.6
Overall Network Travel Time (Hours)	475.1	160.2

The results show a significant benefit to the signalized intersections with the addition of the preferred alternative options. Both of the existing intersections are expected to operate at LOS F and to experience over 100 seconds of delay per vehicle; the addition of the quadrant intersection and rephasing of Mosby Road reduces the delay at these intersections to LOS C. This is particularly noticeable on the through movements on US 11, which will help promote mobility through the corridor. In addition, both of the quadrant intersections are expected to operate at LOS B. Despite the addition of two new signals and the quadrant roadway in Alternative 2A, the overall network benefits from the reduction in travel time and delay through the study area.

4.3 Public Involvement Part 2 / Survey Results

Following the development and analysis of the alternatives, a second public involvement survey was developed to determine the public's response to the alternatives and further investigate their demographics and what they perceived as the relevant issues within the study area. This survey was available online for the entire period of time between January 21, 2020 and February 2, 2020. In addition to providing answers to questions, participants were asked to rank grouped alternatives at sections of the study area to determine the alternatives with the highest public approval. 872 people responded to the survey.

A summary of the key takeaways from the second public involvement survey is as follows:

- Of the participants, 73% are commuters. 85% of the participants operate passenger vehicles.
- A majority of participants agree that changes are needed at the study area locations.
- The top three concerns for survey participants are congestion, safety, and business access.
- The median and sidewalk option (Alternative 5) was favored on US 11. There are concerns about bicycle access along that portion of the corridor. The quadrant intersection improvement (Alternatives 2A and 2B) received minimal public support over taking no action.
- The reduced conflict intersection option (Alternative 7) at Erickson Avenue and Pear Street is strongly preferred compared to taking no action at the intersection.

A detailed summary of the survey questions and results from the second phase of public involvement may be found in the Appendix.

5.0 Conclusions and Recommendations

5.1 Short-Term Recommendations

Due to the fact that it requires no changes to the geometry of the roadway, Alternative 3 is recommended for implementation at the intersection of US 11 and Mosby Road in the near-term to alleviate congestion.

5.2 Preferred Alternative

The preferred long-term alternative recommended by the study team incorporates a combination of Alternatives 2A, 3, 5, and 7. While Alternative 2A may not serve an immediate need within the study area at this time, expected traffic growth in the area will necessitate its implementation due to its ability to improve congestion and safety and its scalability with future traffic growth.

5.3 Final Conclusions

The study and analysis conducted under the US 11 STARS study highlighted a range of issues within the study area that were reinforced by public feedback and involvement. After a full evaluation of the available data, a combination of Alternatives 2A, 3, 5 and 7 provides the most significant improvements to the most prevalent issues and concerns for the traveling public within the study area. This combination of alternatives includes:

- Alternative 2A: Implementing a quadrant intersection at US 11 and Stone Spring Road/Erickson Avenue utilizing existing left turn lane pavement as through lanes that drop at the quadrant intersections.
- Alternative 3: Modifying the existing side street phasing at the intersection of US 11 and Mosby Road from split phasing to concurrent side street phasing with a protected left turn phase for the eastbound approach. Additionally, shifting the existing signalized crosswalk on the northern leg of the intersection to the southern leg of the intersection.
- Alternative 5: The installation of a raised median on US 11 between the aforementioned signals, with the removal of the existing two-way left turn lane and the conversion of all business driveways to right-in/right-out. The exception to this would be at the main entrance to Dukes Plaza, which would retain full access. This alternative would also include the addition of sidewalk on the eastern side of US 11 between the signalized intersections at Stone Spring Road/Erickson Avenue and Mosby Road.
- Alternative 7: The installation of a reduced conflict intersection at Erickson Avenue and Pear Street.

With a thorough and expansive public involvement effort, the options put forth demonstrate support to pursue the concepts outlined towards implementation for funding and are recommended for further development and engineering.

APPENDIX

US 11 Proposed Alternatives Memo

TECHNICAL MEMORANDUM

DATE: November 20, 2019

TO: Brad Reed, AICP
Project Manager

FROM: Nathan Umberger, PE, PTOE
John Albonetti
ATCS, PLC - Traffic Engineering

SUBJECT: VDOT STARS US-11 South Main Street – City of Harrisonburg
Future Alternatives Operational Analysis

INTRODUCTION

This memo summarizes the improvement alternatives considered for the US Route 11 corridor in the city of Harrisonburg, Virginia from Route 726 (Stone Spring Road/Erickson Road) to Route 712 (Mosby Road) as a result of Stakeholders Meeting #2, held September 24, 2019. The alternatives were developed based on the results of the existing conditions and no-build conditions analyses, field observations, and coordination with the Study Team.

SUMMARY OF FINDINGS

In the short-term, removal of the split side street phasing at the intersection of US 11 and Mosby Road in favor of concurrent side street phasing will likely provide an immediate benefit at the intersection. In the long-term, implementation of a quadrant roadway at US 11 and Stone Spring Road/Erickson Avenue and widening Mosby Road to include an additional left turn lane will provide the most substantial benefit for the corridor. At the intersection of Erickson Avenue and Pear Street, an R-cut with a signalized U-Turn crossing is recommended for implementation.

FUTURE YEAR ALTERNATIVES CONSIDERED

The study corridor consists of two major signalized intersections on US 11. They are:

- US 11 and Stone Spring Road/Erickson Road
- US 11 and Mosby Road

The alternatives considered as part of this analysis are as follows:

1. Alternative 1: Conventional Intersection Upgrades at Stone Spring Road
2. Alternative 2A: Quadrant Roadway Intersection at Stone Spring Road
3. Alternative 2B: Quadrant Roadway Intersection with Repurposed Left Turn Lanes at Stone Spring Road
4. Alternative 3: Concurrent Side Street Phasing at Mosby Road
5. Alternative 4: Widening of Mosby Road

The future 2028 volumes used for the purpose of this analysis are shown for US 11 and Stone Spring Road/Erickson Road in **Figure 1** and US 11 and Mosby Road in **Figure 2**.

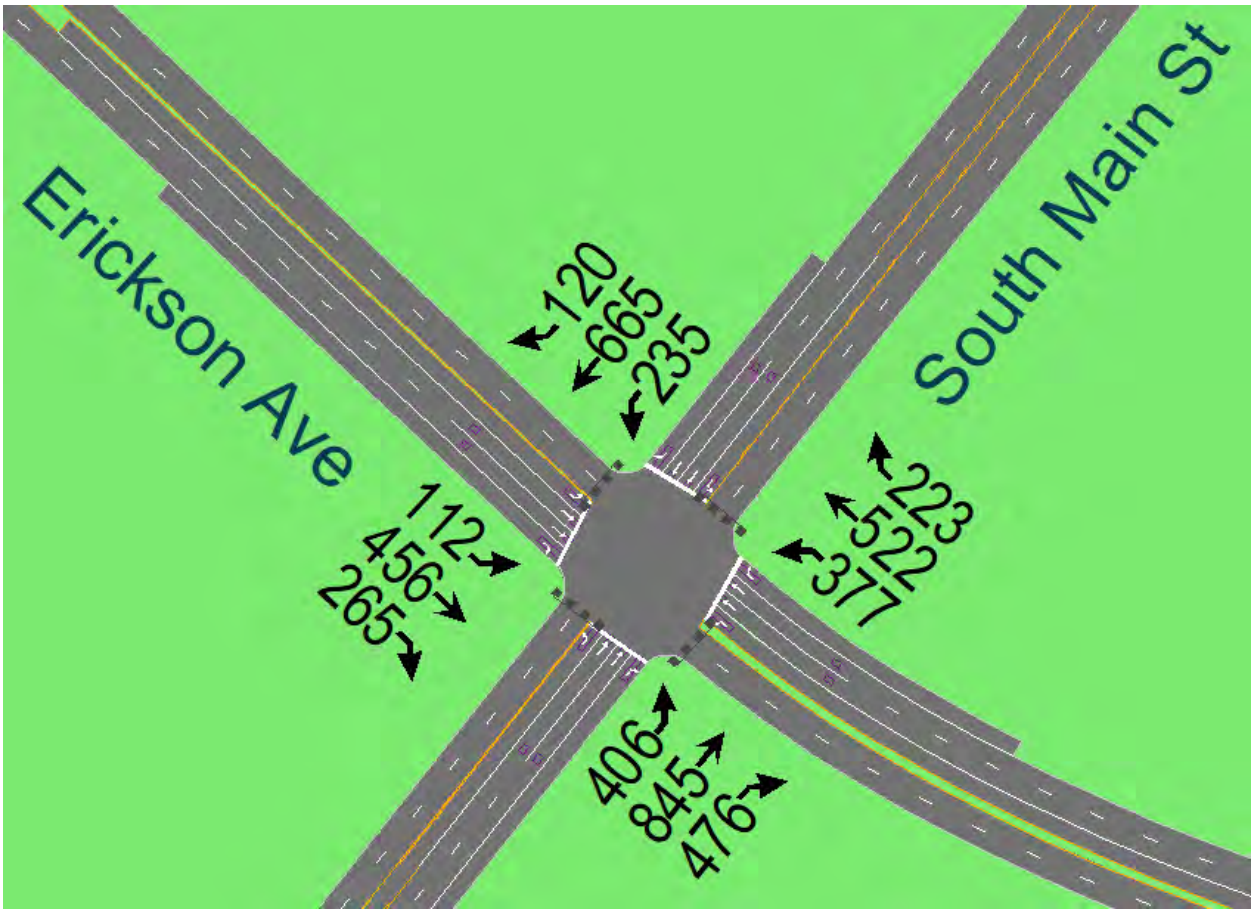


Figure 1: Future 2028 Volumes for US 11 and Stone Spring Road/Erickson Avenue

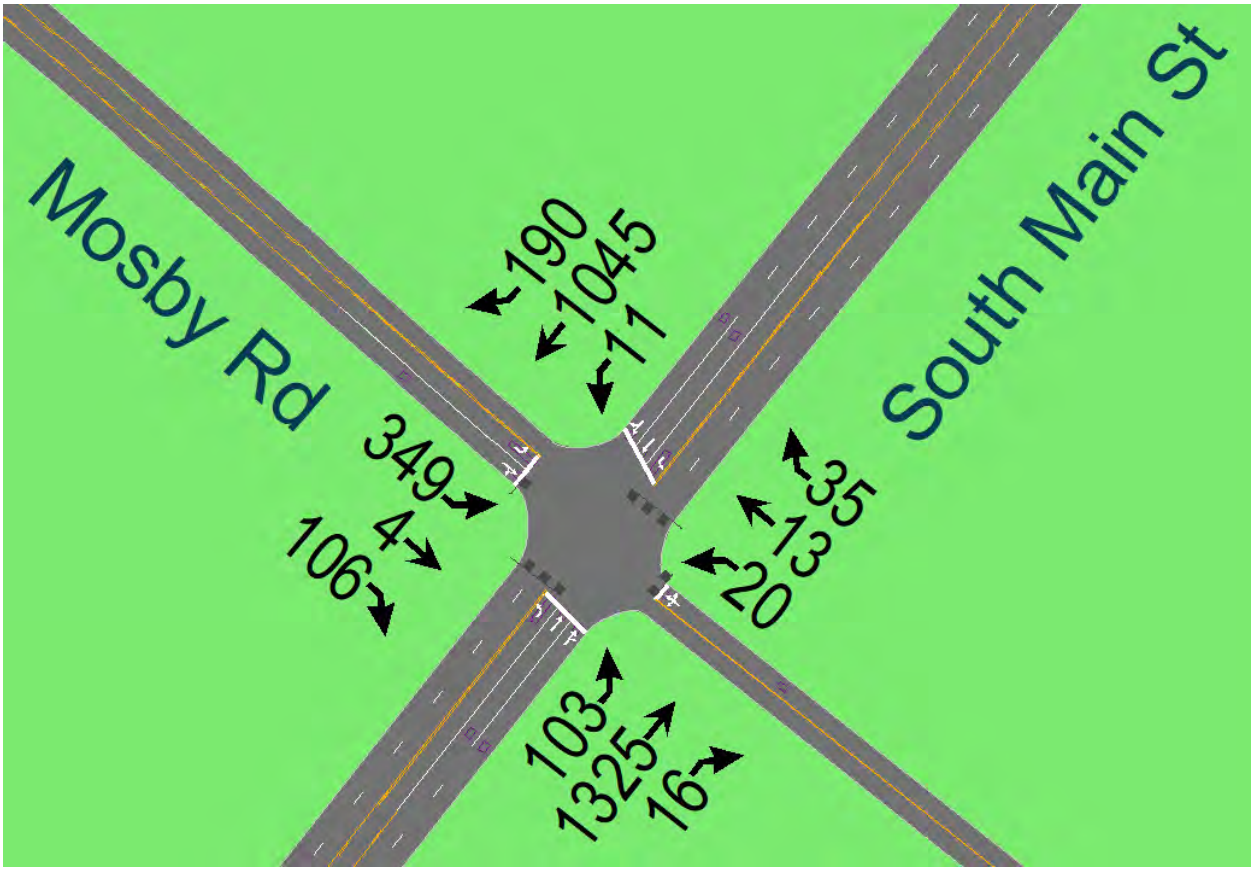


Figure 2: 2028 Future Volumes for US 11 and Mosby Road

This study also provides a short analysis for the proposed intersection improvements at Erickson Avenue and Pear Street to accommodate future development. Existing and future 2027 volumes as well as the proposed alternatives were provided by VDOT from a previous study.

The focus of these alternatives was to improve congestion and safety issues at the intersections and on the corridor in between. Planning level conceptual layouts for each of the proposed future alternatives were developed and are summarized below.

Intersection of US 11 and Stone Spring Road/Erickson Road Alternatives

Three different geometric alternatives were proposed for this intersection. They are summarized as follows:

- Alternative 1: Conventional Intersection Upgrades. This alternative consists of adding an additional left turn lane for both the northbound and southbound directions with minor widening to accommodate the new lanes. This alternative necessitates changing the phasing for those movements from permitted/protected movements with flashing yellow arrow heads to protected only movements. The proposed geometric layout of this alternative is shown below in **Figure 3**.

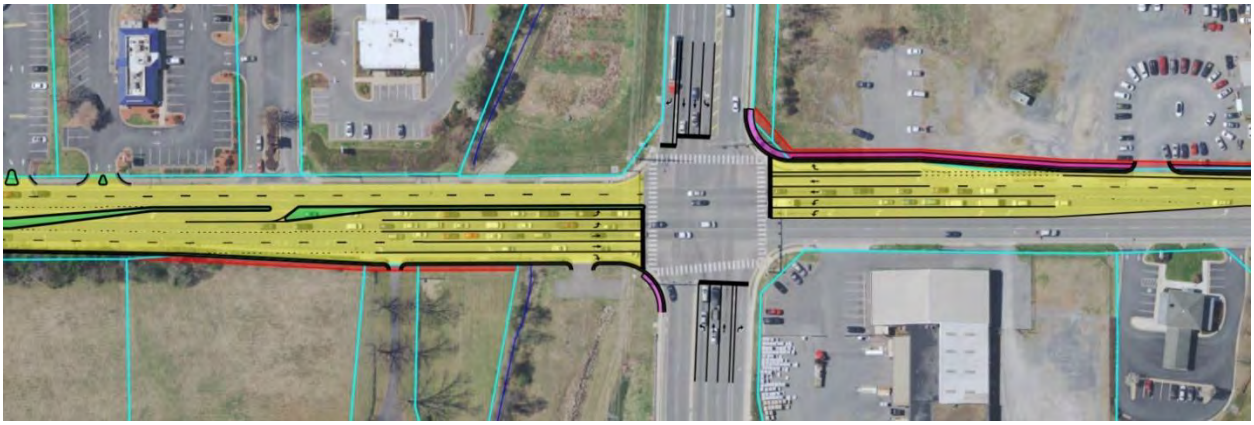


Figure 3: Alternative 1 Proposed Geometric Layout

- Alternative 2A: Quadrant Roadway Intersection. This alternative would add a quadrant roadway to the northwestern quadrant of the intersection, remove all left turns at the Stone Spring intersection, and re-route them through the quadrant roadway at two new signalized intersections north and west of the existing intersection. For the purposes of these analysis scenarios, the quadrant roadway intersections were located 600' north and 500' west of the Stone Spring intersection. These locations were chosen due to being perceived as the ideal tie-in locations for operations and geometric considerations. The proposed geometric layout for this alternative can be seen below in **Figure 4**. The quadrant roadway egress consisted of a left turn lane and a right turn lane and the ingress consisted of from Main Street and Erickson Avenue for the purposes of this analysis. These signals would operate with a permitted/protected left turn into the quadrant roadway. The right turns for the egress from the quadrant roadway were

  All left turns would now travel with the through traffic at the Stone Spring intersection. To make the now-removed left turn movements, northbound left turns would make a left turn at the quadrant roadway intersection north of the Stone Spring intersection and exit with a right turn at the quadrant roadway intersection west of the Stone Spring intersection. Southbound left turns would make a right turn at the northern quadrant roadway intersection and exit with a left turn at the western quadrant roadway intersection. Westbound left turns would make a right turn at the western quadrant roadway intersection and exit with a right turn at the northern quadrant roadway intersection. Eastbound left turns would make a left at the western quadrant intersection and a left at the northern quadrant intersection.

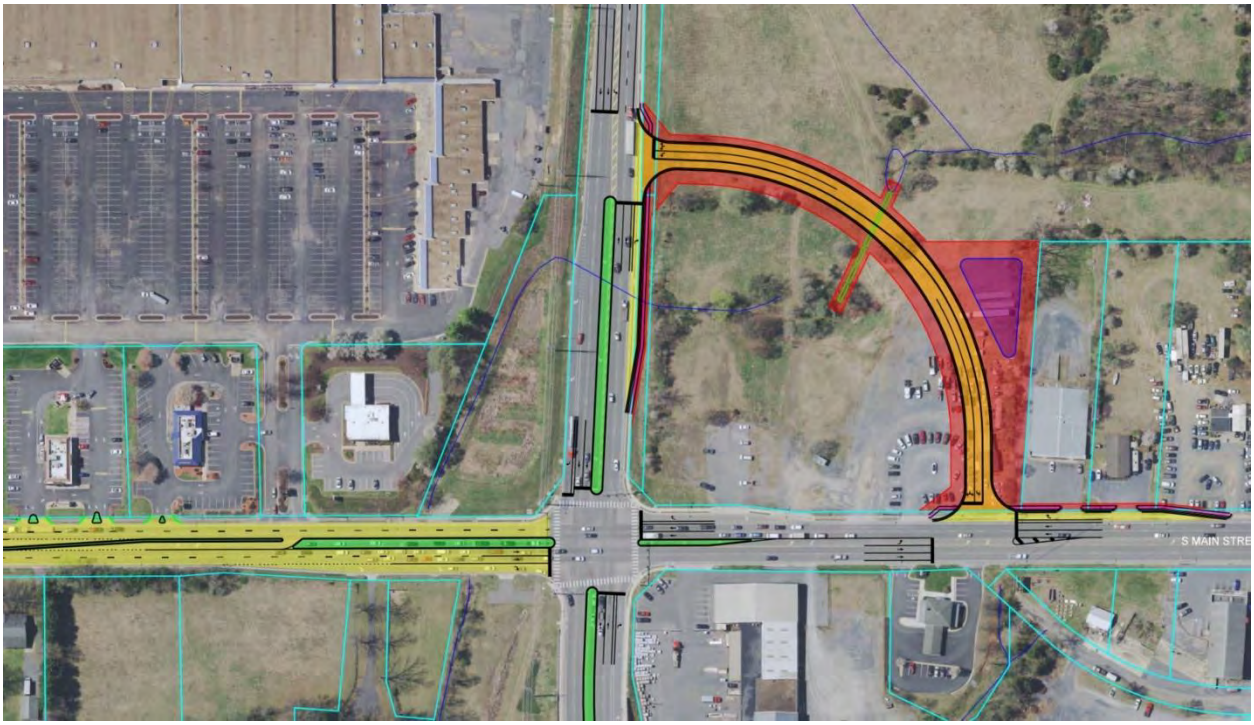


Figure 4: Alternative 2A Proposed Geometric Layout

- Alternative 2B: Quadrant Roadway Intersection with Repurposed Left Turn Lanes. This alternative would use Alternative 2A as a base but would repurpose the existing pavement for the northbound and westbound left turns at the Stone Spring intersection. A representation of this lane use can be seen in **Figure 5**. The northbound left turn lane would be repurposed as a through lane which would tie directly into the northbound left turn lane at the quadrant roadway intersection as a drop lane. The westbound left turn lane would be repurposed into a through lane that would tie into the innermost westbound through lane on the western side of the Stone Spring intersection. The outermost westbound through lane on the eastern side of the Stone Spring intersection would then tie into the westbound right turn lane at the western quadrant roadway intersection as a drop lane.

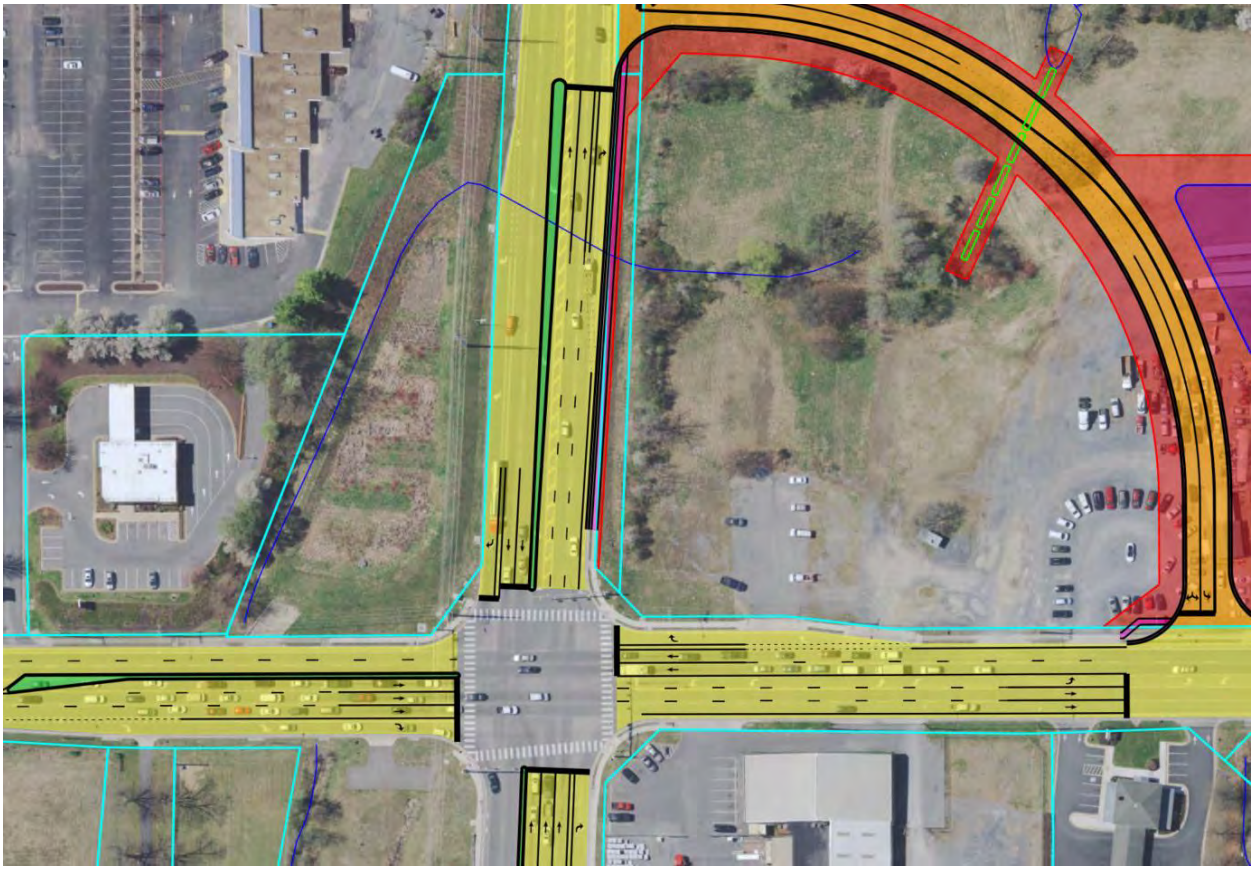


Figure 5: Alternative 2B Proposed Lane Use

Additionally, it is noted that all 2028 future volumes and base Synchro models were provided by VDOT and the City of Harrisonburg as a result of the Traffic Impact Analysis for a new high school south of the study area for use in this study.

Intersection of US 11 and Mosby Road Alternatives

Two different alternatives were proposed for this intersection. They are summarized as follows:

- Alternative 3: Concurrent Side Street Phasing. Currently, the signal at Mosby Road operates with split phasing for the side streets. The amount of westbound traffic at the signal is very low and the time dedicated for the westbound phase causes significant delay on US 11. It was noted during field observations in the PM peak hour that the westbound signal phase would activate for only a single vehicle nearly every cycle. Due to the low number of potential conflicts for the eastbound lefts, more cycle time may be dedicated to the through movements on US 11.
- Alternative 4: Widening of Mosby Road. This alternative consists of adding an additional left turn lane to the eastbound approach at the intersection. The additional capacity afforded by the second left turn lane would allow for more green time to be dedicated to the mainline through movements within the cycle length. The existing split phasing at the intersection would remain to accommodate the dual eastbound left turn lane.

Safety Analysis For US 11 Between The Study Intersections

Though the effects were not tested as part of this analysis, access management improvements are also proposed on the corridor between the two signals. Currently, the existing two-way left turn lane and high number of commercial access driveways on the west side of Main Street present a safety issue. A summary of the angle, rear-end, and sideswipe crashes between January 2013 and May 2019 can be found below in

Table 1.

Commerical Access Segment - First Citizens to Dukes Plaza				
	Total	B	C	PDO
Angle	22	4	0	18
Rear End	30	2	0	28
Sideswipe	7	2	0	5

Table 1: Crash Summary on US 11 Between Stone Spring Road and Mosby Road

Of these crashes, 22 crashes specifically mention ingress/egress the commercial access driveways and six crashes mention conflicts in the two-way left turn lane. To enhance the safety conditions on this portion of the corridor, it is proposed that the two-way left turn lane be replaced with a median and the majority of the commercial access driveways be restricted to right-in/right-out movements. To minimize impacts to the businesses, a dedicated left turn lane would be provided from US 11 to the existing main entrance at Dukes Plaza. Vehicles desiring to exit left from the shopping center would be required to use Mosby Road. In order to accommodate the existing northbound bike lane, the purchase of right-of-way on the eastern side of US 11 would be necessary. Accommodating the existing southbound bike lane on US 11 may not be possible with this geometric configuration and may be better served with the addition of a shared-use path on the western side of US 11. A concept drawing of this portion of the corridor with the proposed median and the inclusion of the northbound bike lane is shown below in **Figure 6**.

Figure 6: Proposed Access Management Improvements on US 11

Results Summary for US 11 and Stone Spring Road/Erickson Road

The first scenarios analyzed were the existing configuration and Alternative 1 using 2028 volumes to compare to the existing intersection results. A summary of these results as compared to the existing 2018

results is shown below in **Table 2**. Queue length results represent the 95th percentile queue. The future models use the 190 second future PM cycle length provided by the City of Harrisonburg. It was noted in the analysis that re-timing the signals to a shorter cycle length did not provide any benefit to the intersection of US 11 and Stone Spring Road/Erickson Road. Splits and offsets for the future models were optimized within the provided 190 second cycle length.

PM Peak Hour Delay, LOS, and Queue Summary											
			2019 Existing Configuration			2028 No-Build			2028 Alternative 1		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Stone Spring Road/Erickson Avenue	South Main Street	NBL	55.5	E	281	92.6	F	828	65.2	E	330
		NBT	50.5	D	315	77.3	E	644	52.0	D	570
		NBR	9.9	A	96	33.1	C	376	23.3	C	222
	South Main Street	SBL	55.4	E	287	65.7	E	441	98.9	F	219
		SBT	49.1	D	341	85.7	F	572	65.4	E	535
		SBR	32.0	C	45	50.7	D	16	42.4	D	9
	Erickson Avenue	EBL	32.7	C	81	44.2	D	141	40.7	D	136
		EBT	54.8	D	264	85.5	F	375	85.7	F	376
		EBR	34.0	C	79	39.3	D	201	50.5	D	116
	Stone Spring Road	WBL	47.6	D	296	95.7	F	638	69.1	E	592
		WBT	42.9	D	265	54.0	D	351	51.2	D	345
		WBR	27.7	C	110	36.8	D	156	36.1	D	110
	Overall		43.0	D	-	69.0	E	-	55.9	E	-

Table 2: 2019 and 2028 PM Peak Hour Analysis Results for Existing Configuration and Alternative 1 at US 11 and Stone Spring Road

Compared to the 2019 existing results, the intersection's performance will degrade significantly by 2028 if the intersection's geometric configuration is left as-is, even with re-timing of the signal. Adding a second left turn lane to the northbound and southbound movements in Alternative 1 alleviates the heightened congestion slightly, but the forced change to protected only phasing for those left turn movements will not allow for significant improvement due to the necessary allotment of split for those phases.

A comparison between the 2028 existing configuration results and the results of Alternatives 2 and 2B can be seen below in **Table 3**.

PM Peak Hour Delay, LOS, and Queue Summary											
			2028 No-Build			2028 Alternative 2A			2028 Alternative 2B		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Stone Spring Road/Erickson Avenue	South Main Street	NBL	92.6	F	828	N/A			N/A		
		NBT	77.3	E	644	10.3	B	254	5.6	A	158
		NBR	33.1	C	376	8.0	A	158	5.5	A	153
	South Main Street	SBL	65.7	E	441	N/A			N/A		
		SBT	85.7	F	572	11.4	B	363	5.0	A	203
		SBR	50.7	D	16	5.9	A	45	2.6	A	30
	Erickson Avenue	EBL	44.2	D	141	N/A			N/A		
		EBT	85.5	F	375	42.3	D	364	55.7	E	394
		EBR	39.3	D	201	35.0	D	154	43.0	D	241
	Stone Spring Road	WBL	95.7	F	638	N/A			N/A		
		WBT	54.0	D	351	65.6	E	638	66.6	E	435
		WBR	36.8	D	156	51.5	D	277	61.6	E	300
	Overall		69.0	E	-	27.8	C	-	27.9	C	-
South Main Street (US 11) and Quadrant Roadway	South Main Street	NBL	N/A			20.6	C	366	18.0	B	316
		NBT				0.8	A	24	1.1	A	42
	South Main Street	SBT				38.2	D	495	38.2	D	495
		SBR				20.8	C	40	20.8	C	40
	Quadrant Roadway	EBL				70.6	E	181	77.0	E	176
		EBR				28.8	C	205	36.3	D	250
	Overall					21.1	C	-	22.0	C	-
Erickson Avenue and Quadrant Roadway	Erickson Avenue	EBL	N/A			14.2	B	71	14.2	B	71
		EBT				7.8	A	219	7.8	A	210
	Erickson Avenue	WBT				13.1	B	497	11.9	B	508
		WBR				0.1	A	0	60.1	E	130
	Quadrant Roadway	SBL				70.2	E	318	71.9	E	319
		SBR				24.0	C	247	25.5	C	254
	Overall					16.8	B	-	26.0	C	-

Table 3: 2028 PM Peak Hour Analysis Results for Existing Configuration and Alternatives 2A and 2B at US 11 and Stone Spring Road

Compared to the existing configuration, both quadrant roadway intersections perform significantly better overall. The new geometry and timing allow for a significant reduction in delay for the mainline through movements, greatly improving mobility through the US 11 corridor. While there are still some movements that operate at a less than ideal delay, this is limited to side street turning movements that are limited due to the significant amount of split afforded to the mainline. The timings could likely be adjusted to allow for slightly more delay on the US 11 mainline through movements at the benefit of improving delay for the side street turning movements.

It was noted during review of the results that the westbound through queue approaching the quadrant roadway intersection on Erickson Avenue utilizes the full length of storage available at the proposed location. This may cause the queues to spill back into the intersection at US 11 and Stone Spring Road/Erickson Avenue. This may potentially be remedied by a reduction in the cycle length, allowing for more frequent clearing of the through queues.

In order to provide a more comprehensive view of the benefit of the quadrant intersection alternatives, total travel time and overall network delay were evaluated for a zone consisting of US 11 and Stone Spring Road/Erickson Road as well as the two quadrant roadway intersections for Alternatives 2A and 2B. These results are summarized for the existing configuration as well as Alternatives 1, 2A, and 2B below in **Table 4**.

Network Measures of Effectiveness	2028 No-Build	2028 Alternative 1	2028 Alternative 2A	2028 Alternative 2B
Overall Network Delay (Hours)	150	68	67	68
Total Travel Time (Hours)	240	94	107	108

Table 4: 2028 Network Results for Stone Spring Road Intersection and Proposed Quadrant Roadway Intersections

As compared to the existing configuration, all three alternatives provide a significant reduction in overall network delay. Of the three, Alternative 1 provides for less overall travel time than the quadrants likely due to vehicles only needing to travel through a single intersection as opposed to three. To further analyze which option would be preferred, a sensitivity analysis was performed. Traffic volumes for these three scenarios were grown by 1% per year for 12 years to produce 2040 volumes. The results for this can be seen below in **Table 5**.

Network Measures of Effectiveness	2040 Alternative 1	2040 Alternative 2A	2040 Alternative 2B
Overall Network Delay (Hours)	199	83	118
Total Travel Time (Hours)	300	128	186

Table 5: 2040 Network Results for Stone Spring Road Intersection and Proposed Quadrant Roadway Intersections

While the two quadrant roadway intersections degrade in performance a fair amount, Alternative 1 shows a significant degradation in these performance metrics in 2040 and performs in a similar manner to the 2028 No-Build option. Based on this analysis, the quadrant roadways will likely be better equipped to accommodate continued traffic growth in the future.

Analysis was also done to estimate the difference in travel time for the re-routed left turn movements at the Stone Spring intersection. Travel time estimates were calculated from and to the same location. For example, the travel time for the eastbound left at US 11 and Stone Spring Road for Alternative 1 was calculated including the travel time for 500 feet on Erickson Avenue eastbound approaching US 11 and 600 feet northbound on US 11 after making the left turn onto US 11 from Erickson Avenue. This accommodates the starting and ending location of the re-routed vehicles through the quadrant roadway intersection. Similar considerations were given for each of the left turn movements. A summary of these results is shown below in **Table 6**.

Estimated Total Travel Time for Left Turns (Seconds)				
Alternative	NBL	SBL	EBL	WBL
Alternative 1	74.9	110.6	62.1	69.1
Alternative 2A	83.1	159.6	82.6	143.9
Alternative 2B	77.3	174.7	83.7	204.0

Table 6: Left Turn Travel Times for US 11 and Stone Spring Road

Though overall intersection delay is low in the quadrant roadway alternatives compared to Alternative 1, the time it takes to travel through the quadrant intersections and the segments between the signals for the re-routed left turns generally adds a high amount of travel time. Despite the degradation in travel

time, the substantial benefits to the through movements at the Stone Spring intersection may help offset this.

Results Summary for US 11 and Mosby Road

Because Alternative 3 only requires changes to the signal phasing and heads, Alternative 3 was analyzed with 2019 volumes to quantify the benefits to the intersection if that alternative was implemented at the present time. The results of this analysis and a comparison to the existing intersection are shown below in **Table 7**. Queue length results represent the 95th percentile queue. For the purposes of this analysis, Alternative 3 was analyzed using the existing PM cycle length of 146 seconds with optimized splits and offset.

PM Peak Hour Delay, LOS, and Queue Summary								
			2019 Existing Configuration			2019 Alternative 3		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Mosby Road	South Main Street	NBL	33.1	C	70	21.0	C	55
		NBTR	73.3	E	682	34.2	C	522
	South Main Street	SBL	33.3	C	12	19.5	B	10
		SBTR	39.6	D	593	22.9	C	295
	Mosby Road	EBL	55.6	E	541	75.1	E	424
		EBTR	38.9	D	0	35.2	D	0
	Mosby Road	WBLTR	63.6	E	63	36.4	D	48
	Overall		57.0	E	-	35.1	D	-

Table 7: 2019 PM Peak Hour Analysis Results for Existing Configuration and Alternative 3 at US 11 and Mosby Road

The results show that removing the split phase at the intersection is likely to provide a substantial short-term improvement to the operations at the intersection. The removal of the split allows for more green time to be dedicated to the mainline through phase and greatly reduces delay for the intersection overall. The increase in delay for the eastbound left turn can likely be attributed to the longer mainline through phases and can be potentially be reduced through adjustment of the timings.

The final analysis comparison was for the existing configuration and Alternatives 3 and 4 in 2028. The results of this analysis can be seen below in **Table 8**. The future models use the 190 second future PM cycle length provided by VDOT. It was noted in the analysis that re-timing the signals to a shorter cycle length did not provide any benefit to the intersection of US 11 and Stone Spring Road/Erickson Road. Splits and offsets for the future models were optimized within the provided 190 second cycle length.

PM Peak Hour Delay, LOS, and Queue Summary											
			2028 No-Build			2028 Alternative 3			2028 Alternative 4		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Mosby Road	South Main Street	NBL	85.7	F	226	36.9	D	119	24.9	C	97
		NBTR	49.9	D	984	34.1	C	898	25.6	C	907
	South Main Street	SBL	20.1	C	4	51.1	D	9	21.4	C	5
		SBTR	47.2	D	863	32.2	C	456	16.0	B	815
	Mosby Road	EBL	73.7	E	797	92.5	F	618	91.1	F	304
		EBTR	52.7	D	68	47.8	D	54	72.8	E	72
	Mosby Road	WBLTR	86.2	F	111	48.6	D	83	86.2	F	111
	Overall		53.3	D	-	40.6	D	-	31.8	C	-

Table 8: 2028 PM Peak Hour Analysis Results for Existing Configuration and Alternatives 3 and 4 at US 11 and Mosby Road

Compared to the existing field conditions, the re-timed existing intersection will potentially operate very slightly better than the existing intersection due to the increased cycle length providing for less delay on the mainline through movements. Compared to 2019, the benefits of Alternative 3 are lessened. Alternative 4, while causing the delay on the side streets to increase, provides a substantial benefit to the mainline through movements and overall benefits the intersection to a significant degree. While Alternative 4 provides for less delay overall, there is some potential for conflict with the proposed access management adjustments to the segment of US 11 between Mosby Road and Stone Spring Road. As the 95th queue shows an 815-foot queue, this would potentially block the cut in the median for the left turn into the main entrance driveway for Duke Plaza. However, as the 50th percentile queue is only projected as 178 feet in the Synchro model, this will likely be a rare issue and should not compromise the other beneficial effects of Alternative 4.

It should be noted that in Alternative 3, the removal of the split phase will likely require adjustments to be made to the existing pedestrian crossing across the northern leg of the intersection due to conflicts with the significant number of eastbound left turns. The preference would be to shift the pedestrian crossing to the southern leg of the intersection. If this is not possible due to potential impacts to the pedestrian ramps, a leading pedestrian phase would be recommended if Alternative 3 is implemented. It also recommended that sidewalk on the eastern side of the intersection be expanded to connect to the bus stops on US 11 in the vicinity of Mosby Road as part of any pedestrian upgrades made to the intersection.

Space Mean Speed on US 11 Between The Study Intersections

In order to provide for an additional measurement of effectiveness of the different alternatives, the northbound and southbound space mean speeds were extracted from the analysis models for the portion of US 11 between Stone Spring Road and Mosby Road. As each of the proposed alternatives only affects one of the intersections, speed data was pulled for the relevant approach to each alternative's particular intersection. A summary of these results is shown below in **Table 9**.

2028 Space Mean Speed and Travel Time on US 11 within the Study Area				
Alternative	NB Speed (MPH)	SB Speed (MPH)	NB TT (Seconds)	SB TT (Seconds)
No-Build	10	15	84.3	56.2
Alternative 1	14		60.2	
Alternative 2A	28		30.1	
Alternative 2B	33		25.6	
Alternative 3		16		52.7
Alternative 4		23		36.7

Table 9: 2028 Space Mean Speed and Travel Time on US 11 within the Study Area

Compared to the No-Build option, the quadrant roadway alternatives provide for a significantly improved northbound speed and travel time on US 11 within the study area. Similarly, Alternative 4 provides for an improved southbound speed and travel time on US 11 compared to both No-Build and Alternative 3.

Results Summary for Erickson Avenue and Pear Street

Presently, the intersection of Erickson Avenue and Pear Street is a two-way stop-controlled intersection with a four-lane mainline on Erickson Avenue and single lane approaches on Pear Street. The intersection currently suffers significant delay on the side street approaches. Projected 2027 volumes for the intersection are shown below in **Figure 7**.

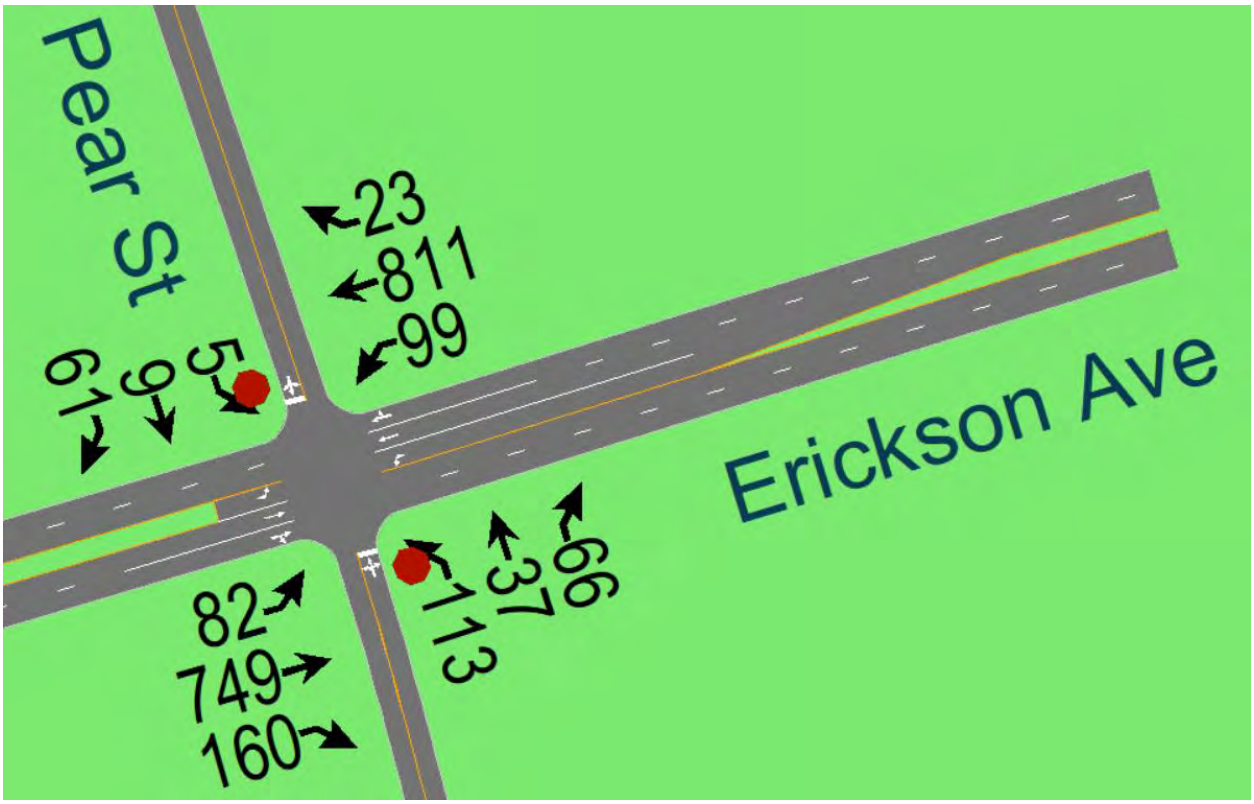


Figure 7: 2027 Future Volumes for Erickson Avenue and Pear Street

Proposed alternatives included signalizing the intersection and providing an R-Cut to the east of the existing intersection. The R-Cut would service the northbound left and through traffic from Pear Street as well as the eastbound left turns from Erickson Avenue. Southbound Pear Street left and through traffic would be serviced as U-turns at the existing downstream signal at Erickson Avenue and High Street. The full analysis results are shown below in **Table 10**.

PM Peak Hour Delay, LOS, and Queue Summary														
			2017 Existing Configuration			2027 No-Build			2027 Build - Signal			2027 Build - RCUT		
Intersection	Roadway	Lane Group	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
Erickson Avenue and Pear Street	Erickson Avenue	EBL	9.9	A	8	10.4	B	10	21.2	C	55	N/A		
		EBTR	0.0	A	0	0.0	A	0	29.6	C	312	0.0	A	0
	Erickson Avenue	WBL	9.1	A	1	10.4	B	12	16.5	B	66	11.1	B	14
		WBTR	0.0	A	0	0.0	A	0	25.3	C	374	0.0	A	0
	Pear Street	NBLTR	264.7	F	207	300+	F	Undefined	72.5	E	297	13.3	B	40
	Pear Street	SBLTR	27.0	D	34	300+	F	Undefined	55.6	E	60	10.4	B	9
	Overall		17.6	C	-	Undefined	F	-	32.2	C	-	1.9	B	-
Erickson Avenue R-Cut	Erickson Avenue	EBU	N/A			N/A			N/A			16.2	B	125
		EBT										0.0	A	0
	Erickson Ave.	WBT										6.1	A	156
	Overall											4.8	A	-

Table 10: Analysis Results for Intersection of Erickson Avenue and Pear Street

Exact analysis results for the 2027 No-Build option were unavailable from Synchro as the extremely high delay was not compatible with how the model generates outputs. The signalized intersection alternative significantly improves conditions at the intersection compared to the No-Build option in 2027, though the side streets still see heavy delay and the mainline suffers from the change from free-flow to signal controlled. The R-Cut option may potentially provide a substantial benefit to the currently substandard movements with little negative impact to the mainline through movements at the intersection, even with the added signalization for the R-Cut.

An option was tested with a non-signalized U-turn that showed no adverse impacts to the operations at the intersection. However, due to the limited sight distance at the intersection, this is not recommended for implementation. Further analysis is being prepared to determine the exact best location of the recommended signalized U-turn with consideration to weaving distance and impacts to the existing roadway and right-of-way. Once the exact location is determined, recommendations for turn lane storage and taper length will also be recommended.

RECOMMENDATIONS

At the intersection of US 11 and Stone Spring Road/Erickson Avenue, the existing configuration and Alternative 1 will likely not provide sufficient capacity for the expected traffic growth in the corridor. The addition of a quadrant intersection in Alternative 2A or 2B may provide for a significant improvement in all measures of effectiveness and is recommended for implementation. Alternative 2B may provide better use of the existing pavement over Alternative 2A and will likely be slightly more cost-efficient whereas Alternative 2B will likely provide for slightly better operations.

At the intersection of US 11 and Mosby Road, there is potential for short-term improvement by removing the existing split side street phasing and implementing concurrent side street phasing with Alternative 3. In the long-term, the removal of the side street split phase will still provide a benefit if widening Mosby Road with Alternative 4 is not feasible. The potential for further improvement with the implementation

of Alternative 4 if widening Mosby Road is feasible results in it being the long-term recommendation for implementation alongside Alternative 2A or 2B.

At the intersection of Erickson Avenue and Pear Street, an R-Cut with a signalized U-turn crossing to the east of the intersection is recommended to provide the best flow of vehicles through that portion of the corridor.

US 11 Access Management Memo

TECHNICAL MEMORANDUM

DATE: January 13, 2020

TO: Brad Reed, AICP
Project Manager

FROM: Nathan Umberger, PE, PTOE
John Albonetti
ATCS, PLC - Traffic Engineering

SUBJECT: VDOT STARS US 11 South Main Street – City of Harrisonburg
Dukes Plaza Shopping Center Future Access Management Evaluation

Introduction

Presently, there is an existing full access commercial driveway on South Main Street between Stone Spring Road and Mosby Road for the Dukes Plaza Shopping Center. If the raised median along this portion of the corridor that is proposed as part of this STARS study is constructed, the individual commercial driveways will be restricted to right-in/right-out movements only. This memo summarizes the analysis performed to determine the effects different access management scenarios may have on the existing main driveway as well as the surrounding roadway network.

Summary of Findings

A full access driveway at the main access entrance to Dukes Plaza on US 11 will likely not operate well due to the inability of vehicles to turn left out of the development and presents safety concerns due to not meeting intersection spacing standards. However, vehicles turning left into the development from US 11 will likely be able to find sufficient gaps in the opposing through traffic. The restriction of left turns out of the main entrance for Dukes Plaza may present a significant burden on the operational capacity at the intersection of US 11 and Mosby Road. The removal of the two-way left turn on US 11 may reduce the effective storage for the northbound left turn lane at Stone Spring Road to a point where queues for the left turn will block adjacent through traffic or upstream left turns into Dukes Plaza.

Due to the likely substandard operational performance of the driveway itself and its interactions with the northbound left turns at Stone Spring Road, a closure of the main driveway to all left turns and a conversion to a right-in/right-out only driveway is recommended.

Discussion of Analysis

Spacing Considerations

In existing conditions, there are access management concerns associated with the main full access commercial driveway into Dukes Plaza on US 11 as it does not currently meet access management standard spacing between a full access driveway and a signalized intersection. The existing spacing

between the main driveway entrance into Dukes Plaza and the intersection of US 11 and Stone Spring Road is shown below in **Figure 1** and the spacing standards for this type of location is shown in **Figure 2**.

Figure 1: Existing Spacing Between Dukes Plaza Main Driveway Entrance and the Intersection of US 11 and Stone Spring Road

Highway Functional Classification	Legal Speed Limit (mph)①	Minimum Centerline to Centerline Spacing (Distance) in Feet			
		Spacing from Signalized Intersections to Other Signalized Intersections ②	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections& Full Median Crossovers ③	Spacing from Full Access Entrances or Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover ④	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover ⑤
Minor Arterial	≤ 30 mph	880	660	355	200
	35 to 45 mph	1,050	660	470	250
	≥ 50 mph	1,320	1,050	555	425

Figure 2: Intersection Spacing Standards

Due to the insufficient space between the driveway and the adjacent intersection as well as safety concerns related to left turns out of the development having to cross over a significant amount of through traffic on US 11 during the PM peak hour, limited access modifications were considered as part of the models developed for this memo.

Assumptions Made

Because no traffic counts were taken at any of the commercial access driveways, traffic for the Dukes Plaza Shopping Center was estimated using trip generation rates from the 10th edition of the *Trip*

Generation Manual, published by the Institute of Transportation Engineers (ITE). The development was assumed to be fully occupied and the size of each generator was approximated using aerial imagery. A 20% internal capture reduction was applied to the generated trips. A summary of the estimated generated trips for the PM peak hour is shown below in **Table 1**.

Development Name	ITE Land Use Code	Approximate Size (Sq. Ft.)	Trip Generation Rate (Per 1000 Sq. Ft.)	Generated Trips	Trips In	Trips Out
Taco Bell	934 - Fast-Food Restaurant with Drive-Through Window	2,700	32.67	88	46	42
Burger King		3,200	32.67	105	54	50
McDonald's		3,900	32.67	127	66	61
Carter Bank & Trust	912 - Drive-in Bank	3,300	20.45	67	34	34
First Citizens Bank		3,500	20.45	72	36	36
Shopping Center	820 - Shopping Center	150,000	3.81	572	274	297
				Total Trips	510	520
				Total Trips After Internal Capture Reduction	408	416

Table 1: Assumed Trip Generation for Dukes Plaza Shopping Center

A network-wide distribution of trips to and from Dukes Plaza was developed by the Virginia Department of Transportation (VDOT) and concurred by the City of Harrisonburg. A representation of the overall distribution is shown below in **Figure 3**.

Figure 3: Trip Distribution for Dukes Plaza Shopping Center Trips

Trips were distributed to the main and individual commercial access driveways on US 11 as well as the access driveways on Mosby Road based on proximity to individual businesses and logic distribution due to signalization. In order to develop a conservative model, 25% of the traffic turning left out of Dukes Plaza onto US 11 with a destination north of the development was assigned to the eastbound left turn movement at the main access driveway. Mosby Road was assumed to service 75% of the left turning outbound traffic from the development. 50% of the traffic turning left into the development from US 11 was assigned to the northbound left movements at Mosby Road and the main access driveway.

Traffic entering the development with a right turn in on US 11 was distributed to the main access driveway as well as the individual commercial access driveways. The main access driveway was assumed to capture all the right turns in for Carter Bank & Trust, 50% of the traffic for the main shopping center buildings, and 50% of the traffic for the Burger King. The same estimate was applied to right turns out at the main access driveway for vehicles with a destination south of the development. The turning movement counts in Synchro for the intersection at Mosby Road were assumed to already include the development traffic distribution as stated above and thus were not altered. Additional traffic assigned to the right-in/right-out driveway entrances was not included in the models. The traffic counts assigned to the main access driveway are shown below in **Figure 4**.

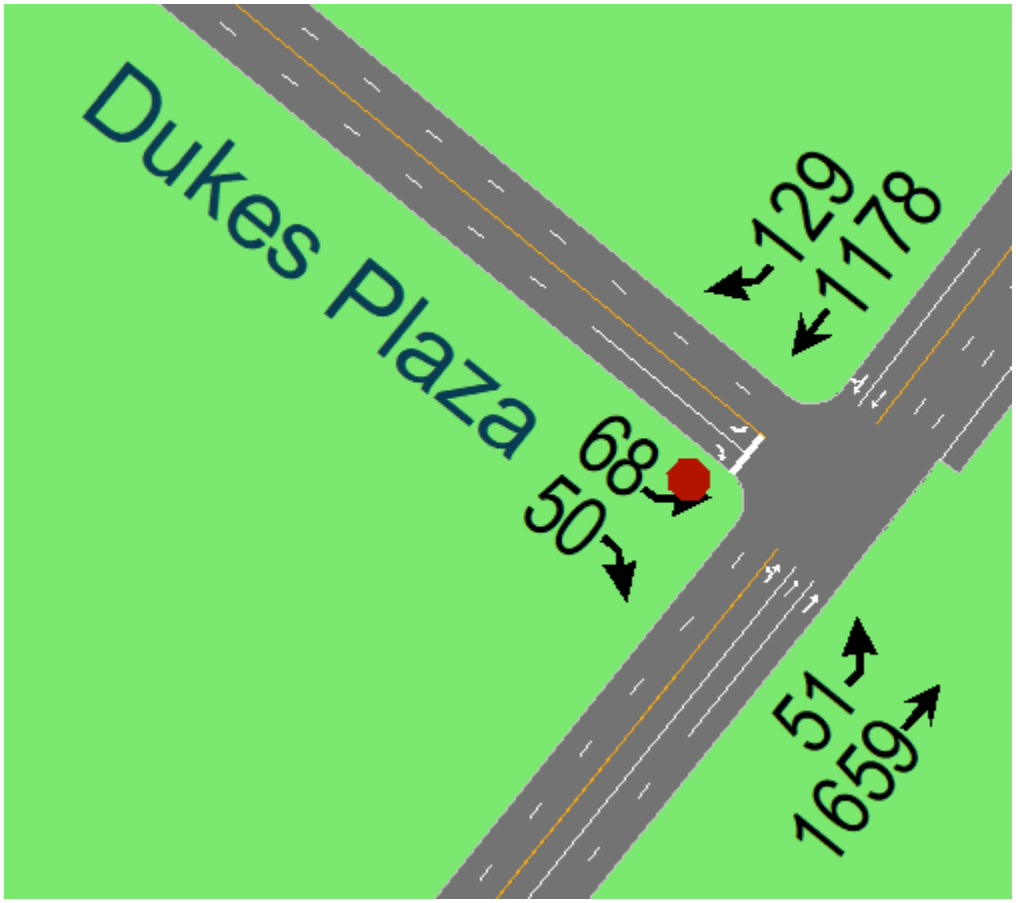


Figure 4: Trip Assignment for Main Entrance into Dukes Plaza Shopping Center

Analysis Methodology

Six scenarios were tested to determine the interaction between different access management improvements applied to the main driveway and the intersections at Mosby Road and Stone Spring Road on US 11. The six scenarios are as follows:

1. Scenario 1: Full Access Main Driveway at Dukes Plaza with No-Build at Mosby Road
2. Scenario 2: Full Access Main Driveway at Dukes Plaza with Alternative 3 at Mosby Road
3. Scenario 3: Full Access Main Driveway at Dukes Plaza with Alternative 4 at Mosby Road
4. Scenario 4: Restricted Access Main Driveway at Dukes Plaza with No-Build at Mosby Road
5. Scenario 5: Restricted Access Main Driveway at Dukes Plaza with Alternative 3 at Mosby Road
6. Scenario 6: Restricted Access Main Driveway at Dukes Plaza with Alternative 4 at Mosby Road

In all scenarios that include full access, no movements will be restricted at the main commercial access driveway at Dukes Plaza on US 11. Restricted access models remove the left turn movement out of the shopping center onto US 11 and reassign those trips to the eastbound left turn movement onto US 11 at Mosby Road. Alternative 3 models test the effects of the removal of split phasing for the side streets at the Mosby Road intersection. Alternative 4 models test the effects of adding a second eastbound left turn lane onto US 11 at the Mosby Road intersection while maintaining the split phasing for the side street movements. No improvements were assumed at the intersection of US 11 and Stone Spring Road in any models. The following geometric assumptions were made:

- In the full access scenario, the northbound left turn lane at Stone Spring Road was configured to act as a continuation of the northbound left turn lane in Dukes Plaza.
- In the restricted access scenario, the northbound left turn at Stone Spring Road was configured as its own turn lane with its own taper, separate from the northbound left turn at Dukes Plaza.

All analysis was performed using SimTraffic with 2028 volumes and signal timings during the PM peak hour.

Analysis Results

Scenarios 1, 2, and 3 were developed primarily to determine if the main access driveway would be able to accommodate a heavy concentration of left turning vehicles both into and out of the development as unsignalized movements across heavy through traffic on US 11. The results of this analysis are shown below in **Table 2**. All queues are noted as representing the maximum queue.

PM Peak Hour Delay, LOS, and Queue Summary											
			Scenario 1			Scenario 2			Scenario 3		
Intersection	Roadway	Lane	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Dukes Plaza Shopping Center	South Main Street	NBL	106.9	F	515	79.0	F	514	29.2	D	514
		NBT	29.8	D	705	14.2	B	699	8.0	A	702
		NBT	12.2	B	734	7.9	A	672	5.4	A	640
	South Main Street	SBT	3.9	A	74	3.9	A	0	3.7	A	0
		SBTR	4.7	A	33	4.5	A	0	20.6	C	0
	Dukes Plaza	EBL	1092.0	F	511	1104.8	F	474	582.2	F	455
		EBR	176.0	F	511	52.7	F	474	7.4	A	70
	Overall		46.2	E	-	33.2	D	-	20.6	C	-

Table 2: Operational Analysis for Intersection of US 11 and Main Access Driveway into Dukes Plaza

It was noted during observations of the SimTraffic simulation that the left turns into the development generally were readily able to find gaps in the opposing through traffic on US 11 due to metering of the traffic from the signal at Stone Spring Road. However, the interaction of vehicles attempting to turn left into Dukes Plaza and vehicles attempting to turn left at Stone Spring within the shared queueing space reduced the efficiency of both movements.

Traffic turning left out of the development was generally unable to find a gap to turn with the exception of a small percentage that was able to turn when traffic was metered by the upstream signal. Right turning traffic was able to turn readily when access to the turn lane was not blocked by the left turn traffic.

Due to the results of these scenarios showing the full access driveway being unfeasible from an operations standpoint, and not preferred from a safety standpoint, Scenarios 4, 5, and 6 were developed to determine the effects of the additional left turning traffic at the intersection of US 11 and Mosby Road. The eastbound left turn movement at this signal is heavy in existing conditions and testing was necessary to determine if the additional volume would significantly affect the overall signal capacity.

For comparison purposes, the Mosby Road intersection results from Scenarios 1, 2, and 3 with no modifications to the turning movement counts at that intersection are shown below in **Table 3**.

PM Peak Hour Delay, LOS, and Queue Summary											
			Scenario 1			Scenario 2			Scenario 3		
Intersection	Roadway	Lane	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Mosby Road	South Main Street	NBL	52.4	D	160	71.3	E	160	73.0	E	160
		NBT	111.0	F	1104	46.1	D	788	35.2	D	598
		NBTR	68.0	E	1086	29.5	C	759	23.8	C	525
	South Main Street	SBL	57.7	E	78	37.2	D	99	51.6	D	99
		SBT	28.7	C	478	25.3	C	463	16.8	B	400
		SBTR	39.4	D	500	36.9	D	479	24.8	C	433
	Mosby Road	EBL	40.3	D	154	40.5	D	154	46.7	D	148
		EBL	N/A			N/A			60.3	E	154
		EBTR	155.8	F	507	125.0	F	488	68.1	E	487
	Mosby Road	WBLTR	71.1	E	136	46.8	D	144	79.8	E	178
	Overall		62.7	E	-	39.3	D	-	32.9	C	-

Table 3: Operational Analysis for Intersection of US 11 and Mosby Road with no TMC Modifications

The results of the analysis for Scenarios 4, 5, and 6 with the redirected left turns is shown below in **Table 4**.

PM Peak Hour Delay, LOS, and Queue Summary											
			Scenario 4			Scenario 5			Scenario 6		
Intersection	Roadway	Lane	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)	Delay (Sec/Veh.)	LOS	Queue Length (Feet)
South Main Street (US 11) and Mosby Road	South Main Street	NBL	75.0	E	160	87.9	F	160	48.1	D	160
		NBT	56.1	E	1066	120.7	F	1842	106.8	F	1676
		NBTR	53.1	D	1030	108.8	F	1869	97.2	F	1673
	South Main Street	SBL	40.7	D	38	44.1	D	99	29.0	C	16
		SBT	37.3	D	572	28.6	C	519	23.3	C	437
		SBTR	47.5	D	556	39.7	D	545	33.8	C	496
	Mosby Road	EBL	35.4	D	154	36.4	D	155	47.3	D	147
		EBL	N/A			N/A			60.4	E	154
		EBTR	153.4	F	506	210.2	F	506	100.7	F	506
	Mosby Road	WBLTR	59.8	E	136	46.5	D	137	73.4	E	144
	Overall		51.5	D	-	76.3	E	-	66.6	E	-

Table 4: Operational Analysis for Intersection of US 11 and Mosby Road with Redirected Left Turns

The additional left turning traffic at Mosby Road shows a significant impact to operations at the signal. Due to the number of eastbound left turns exceeding 400 vehicles during the study hour, a single left turn lane is not able to provide enough capacity for the expected traffic volume. Even with the addition of a second left turn lane in Alternative 4, the signal split required to accommodate the heavy volume negatively affects overall capacity for the mainline at the signal. The maximum southbound through traffic queue is not expected to block the Dukes Plaza entrance in any of these scenarios.

Due to the proposed installation of a raised median, the existing two-way left turn lane on US 11 will be removed. As this is concurrent with the installation of a dedicated left turn lane for the main access driveway into Dukes Plaza a portion of the effective storage for the northbound left turn at Stone Spring Road will be removed. Analysis was performed to investigate the impact of three different access management scenarios for the Dukes Plaza entrance on the northbound queueing at Stone Spring Road. These include a full access driveway, a direction channelized median, and no median break. Models were generated using the Alternative 3 configuration with the removal of split phasing for the side streets at Mosby Road. Geometry for the northbound left turn into Dukes Plaza and at Stone Spring Road were assumed to be the same for the first two scenarios as described in the previous analysis scenarios. In the no median break scenario, the northbound left turn lane for Stone Spring Road extends back to the Mosby Road intersection with no interruptions.

The maximum queues for the northbound left and adjacent northbound through lane at Stone Spring Road are shown below in **Table 5**. The queues for the full access and directional channelized median scenarios are estimated as a summation of the northbound queues for Stone Spring Road and the Dukes Plaza entrance.

Northbound Queues on US 11 at Stone Spring Road for Left Turn Lane and Adjacent Through Lane			
NBL Queues	**Full Access**	**Directional Channelized Median**	**No Median Break**
Maximum Queue (Feet)	893	1,002	711
NBT Queues	**Full Access**	**Directional Channelized Median**	**No Median Break**
Maximum Queue (Feet)	1,077	1,120	541

Table 5: Northbound Queues on US 11 at Stone Spring Road for Left Turn Lane and Adjacent Through Lane

There is currently approximately 340 feet between the stop bar for the northbound left turn lane and the curb line for the ingress into Dukes Plaza. The maximum northbound through queue is likely to extend far enough upstream as to block access to the turn lane if given its own taper. The results of the analysis also show that the queues for the northbound left turn lane are likely to block the through lanes if the lane is given its own taper or block the entrance into Dukes Plaza if treated as an extension of the Dukes Plaza left turn lane.

It should be noted that the results of these models are likely conservative, due to:

1. The assumption that the development is fully occupied at the maximum floor space available based on aerial imagery.
2. The use of the Shopping Center land-use code, which may generate more vehicle trips than a breakdown of the individual businesses within Dukes Plaza.
3. Assumptions made regarding how vehicular traffic generated by Dukes Plaza is distributed between the individual commercial access driveways and at the signalized intersection of US 11 and Mosby Road, in particular left turns.
4. No consideration was given to vehicles that may utilize right turns out of the development onto US 11 southbound in order to make a U-turn at Mosby Road, which may reduce the high number of left turns.

Recommendation

Due to the likely substandard operational performance of the driveway itself and its interactions with the northbound left turns at Stone Spring Road, a closure of the main driveway to all left turns and a conversion to a right-in/right-out only driveway is recommended.

US 11 Design Considerations Memo and Cost Estimate

TECHNICAL MEMORANDUM

DATE: April 3, 2020

TO: Brad Reed, AICP
Project Manager

FROM: Nathan Umberger, PE, PTOE
Deri Harris
John Albonetti
ATCS, PLC

SUBJECT: VDOT STARS US 11 South Main Street – City of Harrisonburg
Design Considerations

INTRODUCTION

The purpose of the US 11 Stars Study in Harrisonburg, VA is to improve traffic operations and safety in the US 11 corridor between Stone Spring Road to just south of Mosby Road while minimizing impacts to private property and utilities. US 11 is classified as a Minor Arterial for this section with a design speed of 35 MPH as noted in Table 1. Note that no field survey nor utility designation has been conducted at the time of this memorandum and the preliminary design is based solely on aerial imagery, GIS information, and field observations.

Design Criteria US 11 (S Main Street)	
VDOT Func. Class.	Minor Arterial
Posted Speed	35 MPH
Design Speed	35 MPH
Min. Lane Width	11'

Table 1: Design Criteria

The study proposal includes installing a 3' wide standard concrete median MC-1 along US 11 to convert existing business entrances to be right-in and right-out only. The entrances themselves will not require any modification. The proposed MC-1 median will have mountable CG-3 curb face to satisfy Harrisonburg Fire Department requirements. The existing left turn lanes at Mosby Road, Stone Spring Road, and at the entrance to Dukes Plaza will remain and the entrance to Dukes Plaza will remain full access. All lane widths will remain 11' wide, and to accommodate the proposed median, the existing bike lanes along US 11 will be eliminated. The existing 5' wide sidewalk on the western side of US 11 will remain and a new 5' wide sidewalk is proposed to be installed within the study area on the eastern side of US 11 for use as a pedestrian facility. The proposed sidewalk will tie into the existing sidewalk along Stone Spring Road and will extend south of Mosby Road to connect to the existing bus stop shown in Figure 1. The bus stop will need to be relocated approximately 25' north to be accessed by the new sidewalk and a new standard bus shelter will be installed. A proposed bus shelter is not feasible at the existing bus stop between Mosby Drive and Erickson Avenue due to the need for a large retaining wall to accommodate the existing terrain. Installing the bus shelter would cost an additional $65,000 including the shelter, retaining wall and additional right-of-way. Two new bus shelters will also be installed on the western side of Route 11 at the existing bus stop locations south of Mosby Drive and between Mosby Drive and Erickson Avenue.

Figure 1: Existing Bus Stop Location

Sidewalk Design

The 2018 AASHTO *Policy on Geometric Design of Highways and Streets* states a minimum buffer width of 2' between the sidewalk and the back of curb should be provided, which matches the City of Harrisonburg standard width of 2' for the same buffer. Therefore, consent from the City will be needed from Sta. 102+00 to Sta. 112+50 for the curb-abutted sidewalk but no design waiver is required. The full buffer width is not able to be provided due to utility poles behind the sidewalk and limited right-of-way. There is approximately 6' between the back of curb and the utility poles and a minimum 1' horizontal clearance is provided between the edge of sidewalk and the utility poles. This leaves space for only the 5' sidewalk with no buffer. In order to provide a full 2' wide buffer, 9 additional utility poles and light poles would need to be relocated. A 4' buffer width is provided from Sta. 112+50 to Sta. 115+00.

Figure 2: Existing Terrain and Utilities

The sidewalk cannot be installed behind the poles due to existing steep slopes that would need to be regraded. This would lead to increased right-of-way acquisition and impacts to private landscaping and parking lots. The design was optimized for the existing terrain observed in the field and seen in Figure 2. In addition, the additional utility relocation or right-of-way impacts would significantly increase the project cost and delay the project schedule in the right-of-way phase. There is adequate space and right-of-way for existing traffic signs to be relocated behind the sidewalk. As the design is further refined, it may be possible to provide a 2' buffer in some areas between poles but as no survey has been completed, it is assumed in the preliminary design that the sidewalk will need to be curb abutted to minimize impacting the slopes and existing features on private property. Installing the sidewalk will also require modifications to the existing entrances along the eastern side of US 11 using standard CG-9.

Cost Estimate

The total cost of the project including the PE, RW, and CN phases is estimated at $1.77 million and is broken down by phases in Table 2 below. This estimate assumes the crown of the roadway does not need to be modified. It also assumes the existing drainage and stormwater management system is sufficient and few if any drainage structures will be needed in the proposed median. Note that no drainage analysis has been performed as part of this preliminary design. The current cost estimate assumes that the existing pavement markings will be eradicated, and no resurfacing will be included in the project. Resurfacing will be performed by the City of Harrisonburg as part of their normal repaving schedule. If slurry seal is required as part of the project, the cost is expected to increase $40K to a total of $1.81 million. If milling and overlaying is required as part of the project, the cost is expected to increase $390K to a total of $2.16 million.

Cost Estimate	
Prelim. Engr. Phase	$347,200
Right-of-Way Phase	$208,550
Construction Phase	$1,215,750
Total	**$1,771,500**

Table 2: Cost Estimate Breakdown

SYIP PROJECTS

DETAILED PROJECT COST ESTIMATE SUMMARY

(Version: 11/14/2019)

Portal ID:	Rte. 11 Access Management	Project UPC:	
Prepared By:	ATCS	Milestone	Creation/Pre Scope
Reviewed By:		Date:	4/3/2020
County/City/Town:	City of Harrisonburg (115)	Tier Level	1

Preliminary Engineering

Project Estimate Component		Proposed Project Cost Estimate ($)		
Discipline	Source	Base ($)	Contingency (%)	Total
Roadway	Consultant	$ 50,000	12.00%	$56,000
Hydraulics	Consultant	$ 20,000	12.00%	$22,400
In-plan Utilities			12.00%	$0
Traffic	Consultant	$ 50,000	12.00%	$56,000
Structures/Bridges				$0
Materials/Geotech	Consultant	$ 40,000	12.00%	$44,800
Survey	Consultant	$ 50,000	12.00%	$56,000
Environmental	Consultant	$ 50,000	12.00%	$56,000
Right of Way	Consultant	$ 50,000	12.00%	$56,000
Other				$0
VDOT Oversight Costs				$0
Total PE Phase Estimate		$ 310,000	12.00%	$347,200
Inflation factor (%)		0.0%		$0
Total Inflated PE Estimate				$347,200
PE Base Estimate Date (XX/XXXX)				
PE Phase Start Date (XX/XX/XXXX)				

Right-of-Way & Utilities

Discipline	Source	Base ($)	Contingency (%)	Total
Right-of-Way		$34,000	50.00%	$51,000
Out-of-Plan Utilities (power, cable, gas, etc.)		$137,000	15.00%	$157,550
VDOT Oversight Costs				$0
Total RW Phase Estimate		$171,000	21.96%	$208,550
Inflation factor (%)		0.0%		$0
Total Inflated RW Estimate				$208,550
Base Estimate Date (XX/XXXX)				
RW Phase Start Date (XX/XX/XXXX)				

Construction

Discipline	Source	Base ($)	Contingency (%)	Total
Mobilization		$65,000	40.00%	$91,000
MOT		$75,000	40.00%	$105,000
Roadway		$323,000	40.00%	$452,200
Hydraulics		$122,000	40.00%	$170,800
In-plan Utilities		$0	40.00%	$0
Traffic		$120,000	40.00%	$168,000
Structures/Bridges		$0	40.00%	$0
Materials/Geotech		$0	40.00%	$0
Soundwalls		$0	40.00%	$0
Other (Transit)		$30,000	40.00%	$42,000
Total Bid Items		$735,000	40.00%	$1,029,000
Incidental - Claims & Work Orders (5% to 10% max)	5%	36,750		36,750
Railroad Flagging/Coordination		0		0
State Forces		0		0
State Police		0		0
Contract Requirements (Incentive/Disincentive)	5%	0		0
Construction Engineering (Inspection)	Environmental Inspection ($)	50,000		50,000
	VDOT or Locality ($)	50,000		50,000
	VDOT Oversight ($)	50,000		50,000
	Total CEI			150,000
Total CN Phase Estimate		$921,750	31.90%	$1,215,750
Inflation factor (%)		0.00%		$0
Total Inflated CN Phase Estimate				$1,215,750
CN Base Estimate Date (XX/XXXX)				
CN Phase Start Date (XX/XX/XXXX)				
CN Phase End Date (XX/XX/XXXX)				
Total Project Cost Estimate				$1,771,500

STARS Program - Framework Document

Route 11 (S. Main Street) Corridor Improvement Study & Erickson Ave. Preliminary Design

1. Stakeholder Acceptance

The undersigned parties from VDOT, Harrisonburg and HRMPO concur with the methods and assumptions for the Route 11 (Main Street) Corridor Improvement Study as presented in this document.

VDOT (District PM):	VDOT (TMPD):	City of Harrisonburg
Signature	Signature	Signature
Asst. District Planner	Planning Spec Sr Supv	DIRECTOR of PUBLIC WORKS
Title	Title	Title
8/8/19	8/6/2019	8/7/19
Date	Date	Date

HRMPO:

Signature

Transportation Program Manager

Title

8/7/19

Date

(1) Signing of this document does not constitute approval of the Route 11 (Main Street) Corridor Improvement Study & Erickson Avenue Design Work.
(2) All members will use this document as a guide and reference as the study progresses through the various states of project development. If there are any agreed upon changes to the assumptions in this document, a revised document will be prepared and signed by the parties who originally signed it.

2. Introduction and Purpose

Route 11 (S. Main Street) in the City of Harrisonburg is a major arterial route with observed operational issues at the intersection of Erickson Avenue/Stone Spring Road which has several major left turning movements, as well as existing safety concerns on the corridor extending to the south. The City of Harrisonburg has also established through a land development traffic study that there will be future operational and safety issues at the intersection of Erickson Avenue & Pear Street that may not be adequately resolved with signalization. The City has developed a preliminary concept for an innovative intersection treatment that will be refined and advanced. The purpose of this Strategically Targeted and Affordable Roadway Solutions (STARS) project is two-fold. First, it will evaluate operational and safety conditions and identify short- and long-term improvements that can be programmed into the Virginia Department of Transportation's (VDOT) Six-Year Improvement Program (SYIP) for a segment of S. Main Street from Mosby Road to Stone Spring Road/Erickson Avenue. Second, it will evaluate and perform preliminary design work for the conceptual treatment developed by the City of Harrisonburg for the Erickson Avenue & Pear Street intersection. The S. Main Street alternatives evaluation will consider operational and safety improvements through geometric design, access management improvements, lane utilization/repurposing and innovative intersection or interchange configurations. Advancement of work on the intersection of Erickson Avenue and Pear Street will include an assessment of the function and feasibility of the conceptual treatment, analysis of beneficial modifications to this concept, and preliminary design plan development. This framework document outlines the scope of work and associated assumptions for the aforementioned project. The assumptions used in this framework document align with the standards and guidance from VDOT's Traffic Operations and Safety Analysis Manual (TOSAM), the VDOT Road Design manual, and applicable City standards.

This project is scheduled to be completed no later than March 2020.

The general schedule will be as follows:

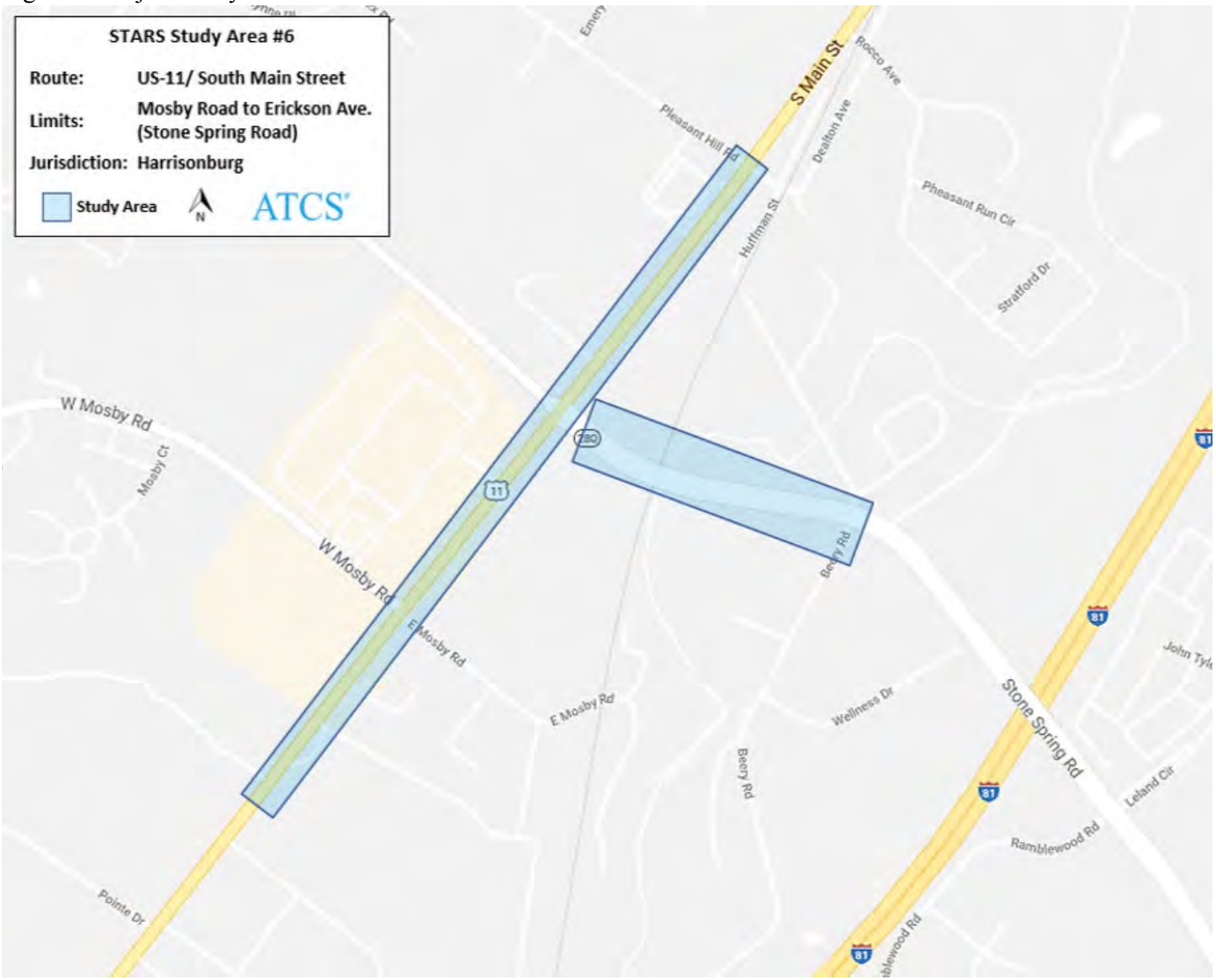
- September – Existing Conditions/Alternatives Screening Workshop
- November – Alternatives Development & Evaluation Workshop
- January – Final Recommendations and Public Involvement Planning Workshop
- March – Delivery of Final Report and all associated Documentation

3. Project Study Area

The study area for this project is shown in Figure 1. The study area, hereafter referred to as the "study corridor", primarily consists of a section of Route 11 (S. Main Street) between the functional areas of the Mosby Road to Stone Spring Road/Erickson Avenue intersections, approximately 0.50-mile in length. Also, as part of this STARS effort, ATCS will more thoroughly advance concept design for the intersection of Erickson Avenue and Pear Street shown in Figure 2. The study corridor includes two primary intersections and direct access points to adjacent properties. The significant study corridor intersections are listed in the table below.

Int #	Description	Control
1	US-11/Main Street at Mosby Road	Signalized
2	US-11/Main Street at Stone Spring Road/Erickson Avenue	Signalized
3	Erickson Avenue at Pear Street (Design Only)	Unsignalized

Figure 1: Project Study Area



ATCS

Figure 2: Erickson Avenue at Pear Street Intersection Concept

ATCS®

4. Analysis Years / Periods & Project Data

This study will analyze existing conditions in 2019 and future conditions in 2028. The time periods to be analyzed for existing and future conditions include weekday AM and PM peak hours at all corridor signalized intersections. In addition, analyses of selected unsignalized intersections will also be undertaken. The field data collection program is to be conducted as part of a Traffic Impact Analysis effort for a new High School campus near the study area being handled by Monteverde Engineering & Design Studio. The collection, which was completed from April to June 2019 to account for school traffic, includes the following data elements:

- ☐ Two Hour Weekday AM & PM Peak Hour turning movement counts (City of Harrisonburg)
- ☐ Weekday volume and classification ADT counts for two roadway segment locations (VDOT count program data)
- ☐ Weekday corridor travel time runs and speed data (City of Harrisonburg)
- ☐ Weekday intersection queue lengths at intersections to be analyzed (ATCS)

Design Work for the Erickson Avenue intersection will include analysis of PM peak hour conditions in a 2027 future year condition using traffic data and modeling from the 2017 Wenger-Burkholder Residential Development Traffic Impact Analysis. The City of Harrisonburg will provide as-built plans for Erickson Avenue. ATCS will determine if additional ground survey work is required and will coordinate with VDOT prior to proceeding with such work.

5. Traffic Operations Analysis

The City of Harrisonburg will provide the most current signal timing plans and/or Synchro files, if available, for the corridor. The traffic operations analysis and simulation will be performed using Synchro 10/SimTraffic 10 software for all the study intersections along the arterial corridor. Inputs and analysis methodologies will be consistent with VDOT's Traffic Operations and Safety Analysis Manual (TOSAM) and will be documented with the calibration of existing conditions memo. The ATCS Team will calibrate existing conditions SimTraffic models based on simulated traffic volumes, travel time runs, and queue lengths at critical signalized intersections as detailed in TOSAM.

For the Erickson Avenue design work, the City of Harrisonburg will provide the 2027 Synchro models used for the 2017 Wenger-Burkholder Residential Development Traffic Impact Analysis. ATCS will provide a comparison of development build out conditions without signalization (presented in TIA), with signalization (presented in TIA), and with the preferred intersection alternative at Erickson Avenue & Pear Street. Turning path software will be used to validate the proposed U-Turn locations, with a transit bus design vehicle for the eastbound U-Turn and a passenger car design vehicle for the westbound U-Turn at Route 42. A viable pedestrian path to cross Erickson Avenue at Pear Street will be evaluated and incorporated into the intersection design.

6. Safety Analysis

The ATCS Team will conduct a crash analysis for the study corridor using the latest five years of available crash data from VDOT's crash database. The ATCS Team will review, analyze, and summarize the crash data by year, severity, type, time of day, location. The team will identify any crash patterns, and likely causes for crashes, and develop collision diagrams at key locations to further understand vehicular behaviors of each crash. The team will develop collision diagrams for the overall corridor.

The team will conduct AM and PM peak period field reviews of the study corridor to review traffic conditions, driver behavior, geometric layouts, and the presence and condition of signing, pavement markings, and delineation. Following completion of the field reviews, the team will provide recommendations for varying levels of mitigation. Typical recommendations will include signing/pavement marking improvements, sight distance improvements, improvements to traffic and pedestrian signals, as well as bike and pedestrian facilities. These recommendations will be based on historical crash data, field reviews and a review of compliance with the Manual on Uniform Traffic Control Devices (MUTCD) and VDOT/COUNTY/CITY/LOCAL standards and policies. Recommendations will also include "maintenance-type" safety improvements which are expected to be low-cost and short-term measures. The recommendations will be utilized to conduct a crash reduction analysis using Crash Reduction Factors related to SMART SCALE to determine effects of potential safety improvements. The team will calculate the crash reduction benefit/cost by assigning monetary value to crash reductions using the VDOT Highway Safety Improvement Program (HSIP) costs.

A summary of five-year crash severity and type without a detailed crash diagram will be reported for the Erickson Avenue & Pear Street intersection.

7. Traffic Forecasting

Traffic forecasting for the 2028 future year on the study corridor will be taken directly from the Harrisonburg High School Traffic Impact Analysis. Forecasting for the Erickson Avenue design work 2027 future year will be taken directly from the 2017 Wenger-Burkholder Residential Development Traffic Impact Analysis. Further sensitivity analysis may be conducted based on alternatives proposed and analyzed for the study corridor and the Erickson Avenue intersection design work, and those years will be selected by Study Team to assess potential future levels of service. ATCS will work with the Staunton District and City of Harrisonburg to develop and apply an average annual growth rate (AAGR) to the 2028 forecast volumes to generate future year traffic forecasts for sensitivity analysis where needed.

Volumes developed by ATCS for sensitivity analysis years will be reported and summarized in graphical format and will be submitted to VDOT for review and approval prior to initiation the analysis.

8. Concept Development and Cost Estimates

Based upon the 2028 No-Build operational analysis results, safety analysis, as well as field investigations, the team will identify operational and safety deficiencies within the study area and develop improvement alternatives along the corridor. The team will then present and discuss an initial set of potential improvements with VDOT and the City to determine those that should be analyzed in greater detail.

An initial screening will be performed using Synchro 10 software and/or the VDOT Junction Screening Tool (VJuST), where applicable, to test innovative intersection concepts that may be advanced to more detailed testing. ATCS will present preliminary alternatives at an in-person Existing Conditions/Alternatives Screening Workshop

with will involve a decision matrix with results of the planning level analysis, approximate cost ranges, and concept sketches. The study team will work through these and select up to 2 corridor/intersection alternatives to advance to deeper analysis of 2028 traffic volumes utilizing SimTraffic. The ATCS team will present the findings of the analysis to the Study Team during an in-person "Alternatives Development & Evaluation Workshop" at which point the study team will refine specifics of the alternatives and associated concepts in order to finalize the analysis. At the final team meeting, the study team will walk through the final results, plan the public meeting, and select a preferred corridor alternative for final report out.

Pending final guidance from VDOT Central Office, the team will prepare planning-level cost estimates for the improvements' construction costs for each of the preferred alternatives using the current version of the Project Cost Estimating System (PCES), Version 8.1. ATCS will consult with District L&D for their input regarding right-of-way, utility relocation costs and will adjust PCES estimates with appropriate assumptions. The initial cost estimates prepared by ATCS will be submitted for review by VDOT and the City of Harrisonburg, they will then be revised as needed based upon this review. ATCS will develop planning level sketches of the preferred corridor improvements that meet Smart Scale program sketch requirements. Preferred study corridor improvements will be prioritized and, if appropriate, bundled into separate projects based on an implementation pathway recommended by ATCS. ATCS will develop one-page, graphical executive summary sheets on STARS templates for each project displaying the brief project description in plain language, sketch, cost estimate, schedule, and a summary of reported benefits.

For the Erickson Avenue design work, ATCS will develop design plans and an engineering cost estimate to the maximum extent possible, estimated to be 20-30%, based upon As-Built Plans of Erickson Avenue. ATCS will use the VDOT staff coordination procedures described above for the final intersection concept. Additional work, such as survey or geotechnical exploration, to reduce risk and maximize development may be added at a later point in the study as deemed necessary and appropriate.

9. Measures of Effectiveness (MOE)

MOEs for intersections will include Synchro/SimTraffic output for HCM 6th Edition control delay (sec/veh)/microsimulation delay (sec/veh) and 95th percentile queue length (ft)/maximum queue length (ft). Unsignalized intersection operations will be reported as Stop Control Approach delay (sec/veh)/microsimulation delay (sec/veh) and maximum queue length (ft). Corridor-level MOEs for S Main Street will be reported from SimTraffic and include space mean speed (mph) and travel time (min:sec) for NB and SB travel from Pleasant Hill Road to Mosby Road. MOEs will be documented in figure and/or tabular format. For Safety Analysis, Virginia specific CMFs will be applied where available to determine projected reductions in crashes.

10. Public Outreach

VDOT will work with the study team to develop a survey of public opinion regarding existing corridor conditions and conceptual, generalized treatment types. The City of Harrisonburg will publish the survey to the general public in advance of the Existing Conditions/Alternatives Screening Workshop so that results can inform development of preliminary alternatives. VDOT and the City of Harrisonburg will conduct a public meeting following the analysis of the preferred study corridor alternative and development of draft preliminary engineering drawings for the Erickson Avenue & Pear Street intersection concept. The ATCS Team will provide display boards and related materials for the public meeting and will present the study findings and intersection

design concept using a Powerpoint presentation. VDOT will revise the public survey for re-release as desired by the study team. The City of Harrisonburg will advertise and host the event, and will facilitate an online portal for submission of stakeholder comments and the survey following the event.

Public Involvement Phase 2 Survey Summary Presentation

S. Main St. (US-11) & Erickson Ave. Study
Online Survey Results Summary

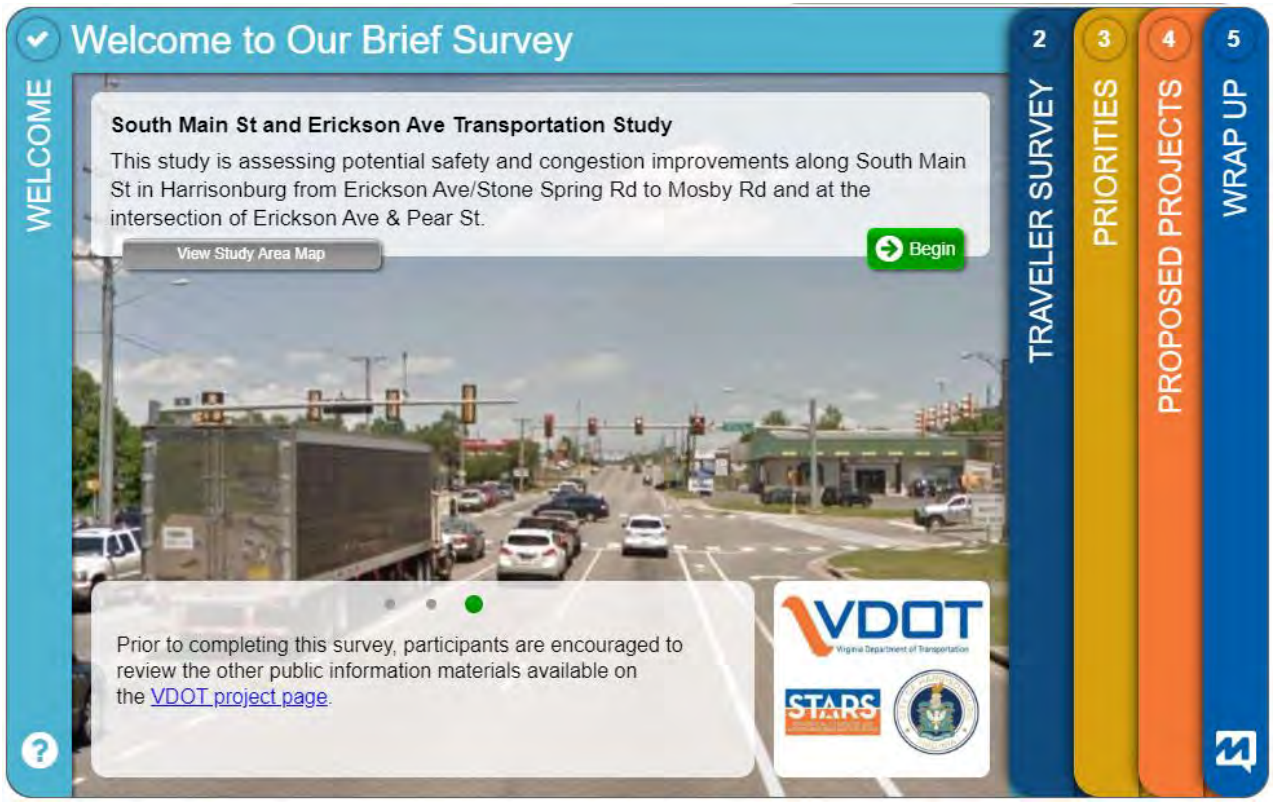
Agenda

- Introduction
- Survey Analysis
  - Corridor Use & Issues
  - Corridor Priorities
  - Alternatives Survey
  - Respondent Info
- Key Takeaways

Introduction

- Study Areas:
  - US-11 (S. Main Street) from Erickson Ave./Stone Spring Rd. to Mosby Rd.
  - Intersection of Erickson Ave. & Pear St.

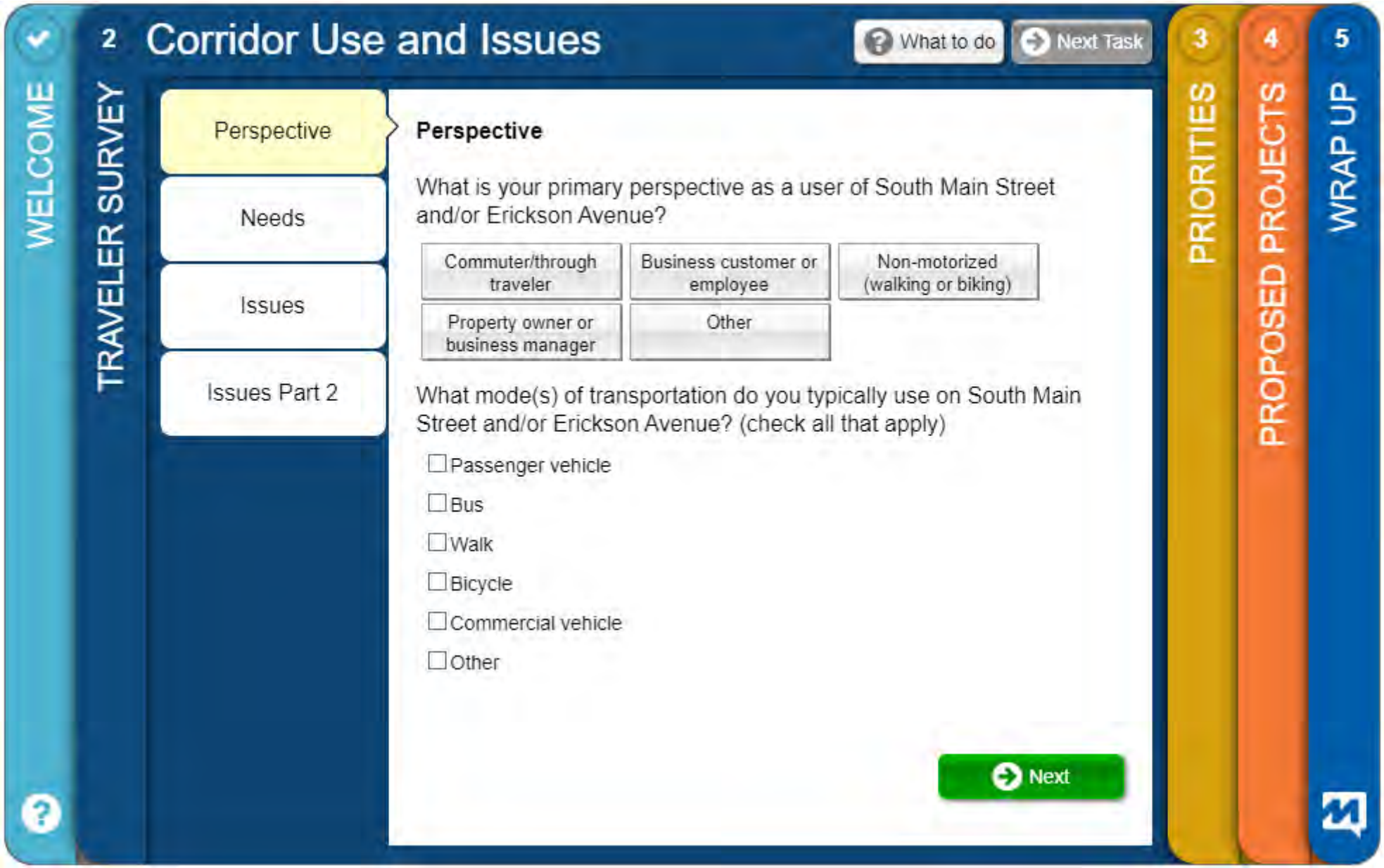
- Online survey available from January 22 to February 14, 2020

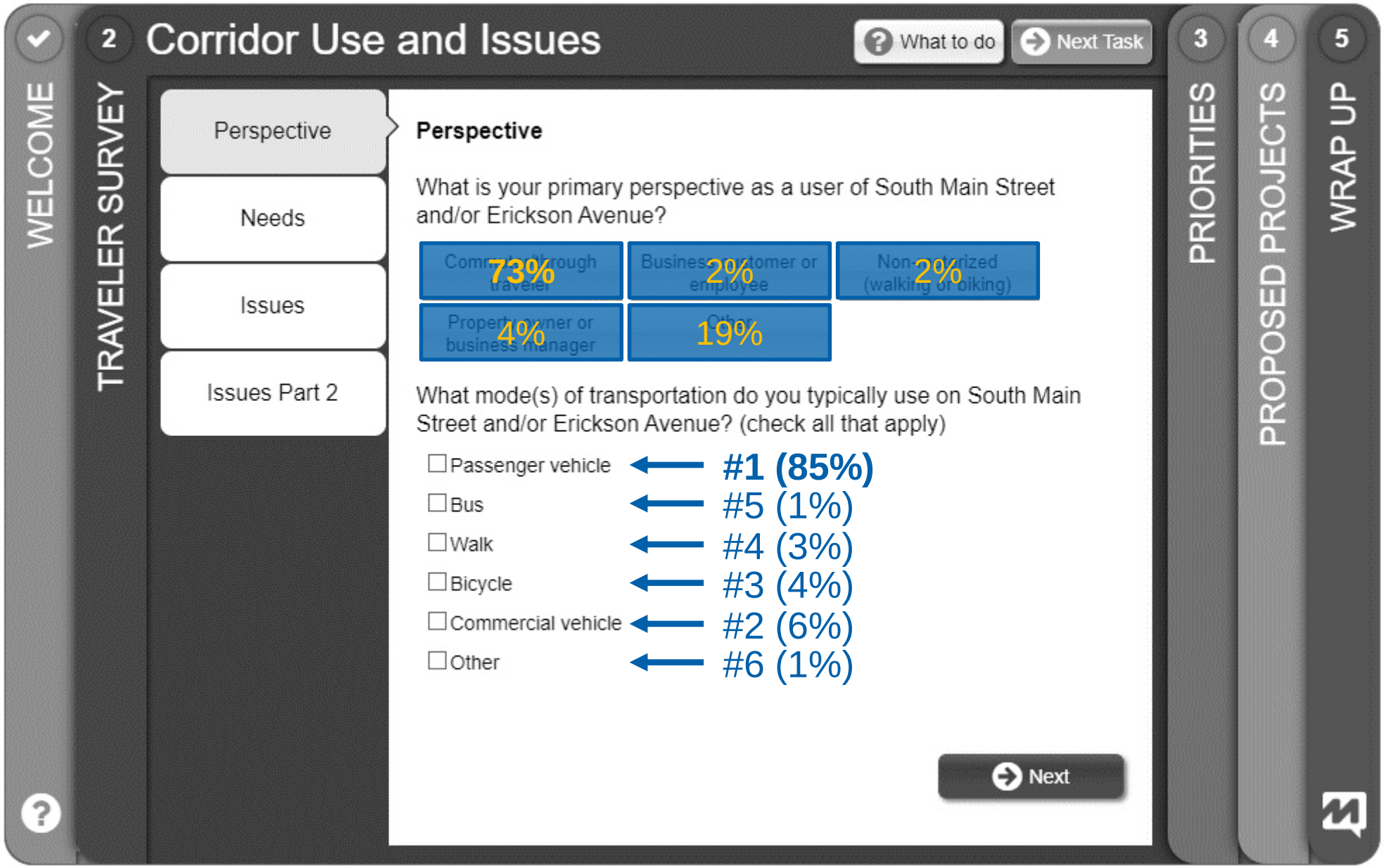


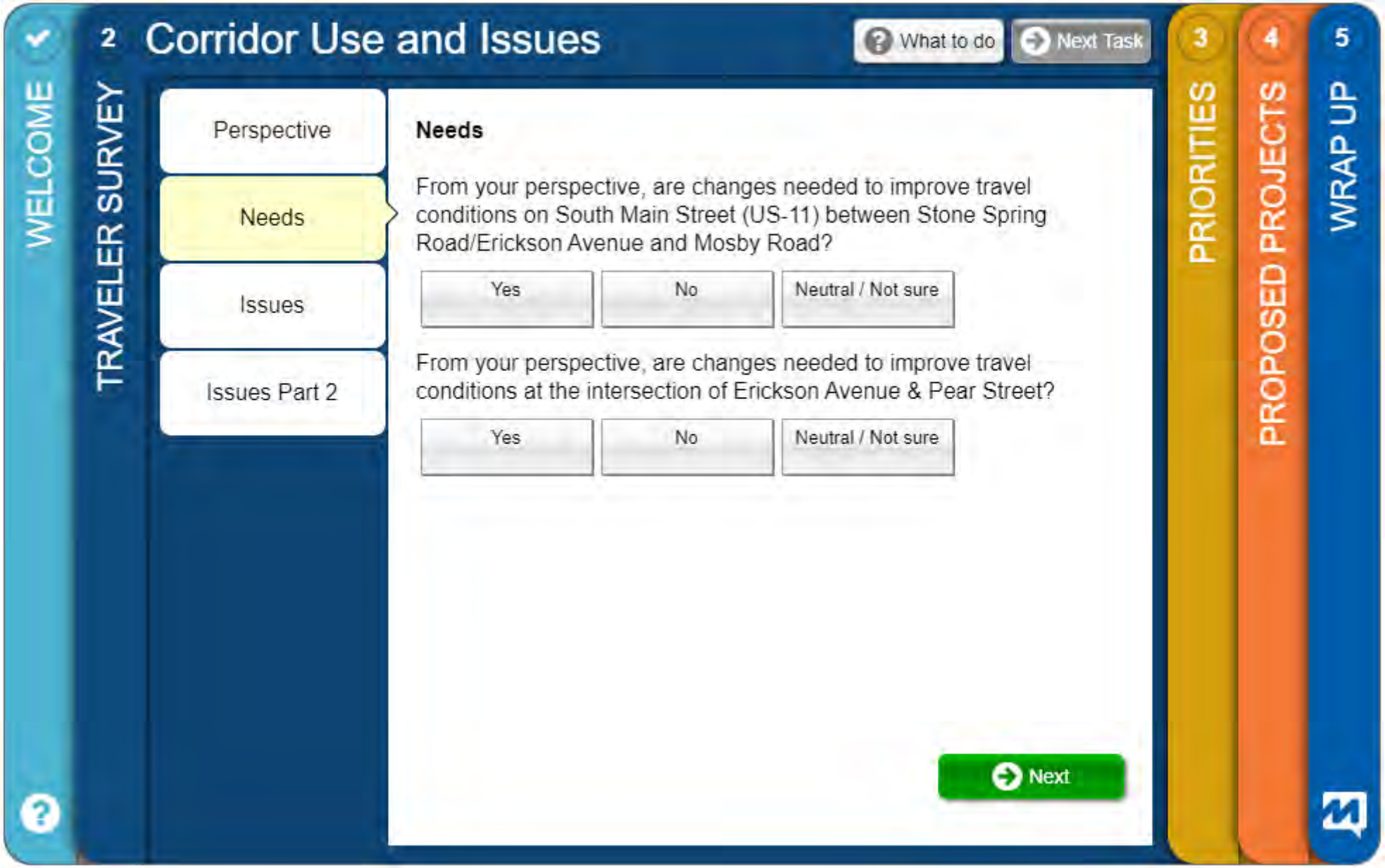
872
completed surveys

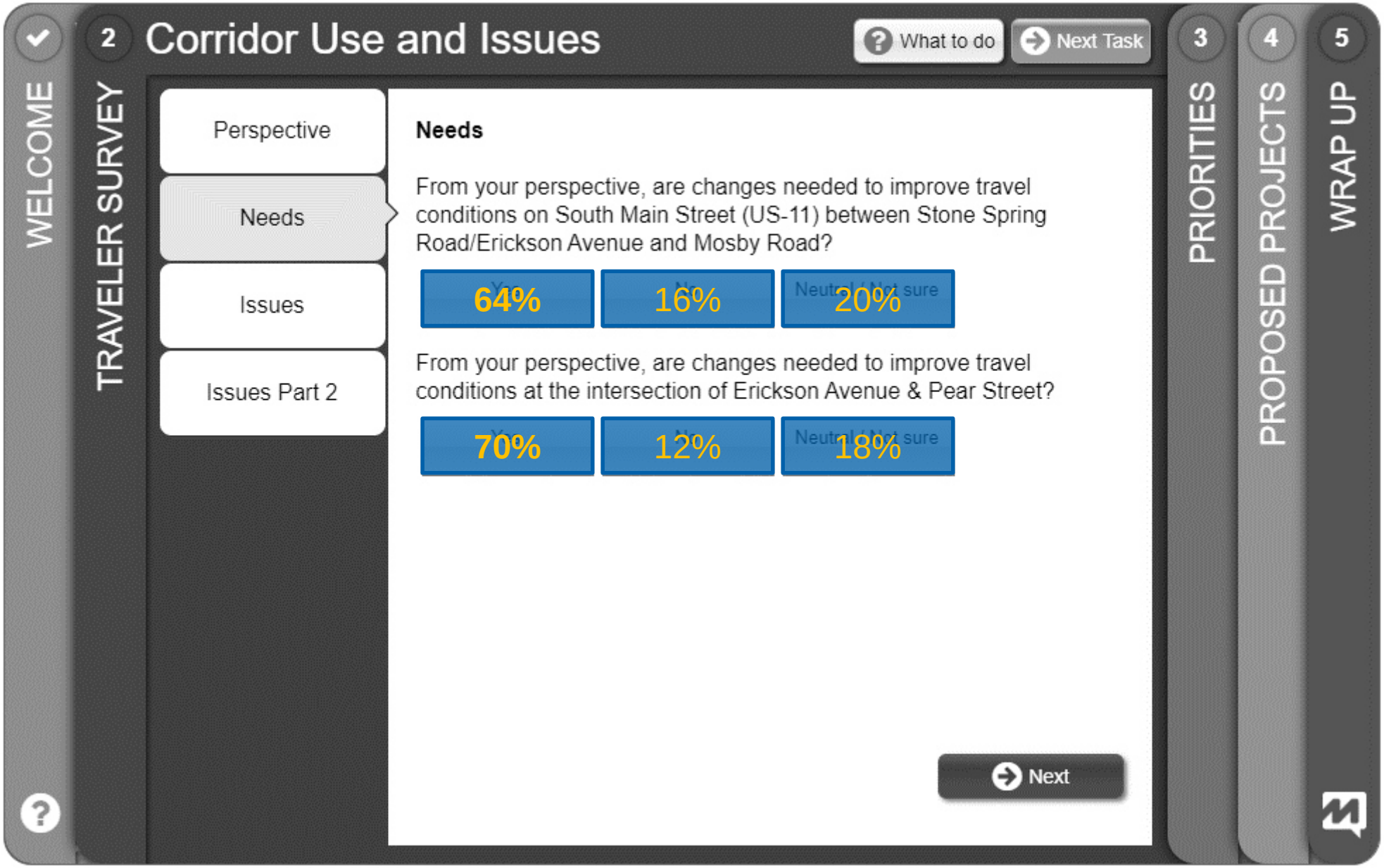
382
additional comments

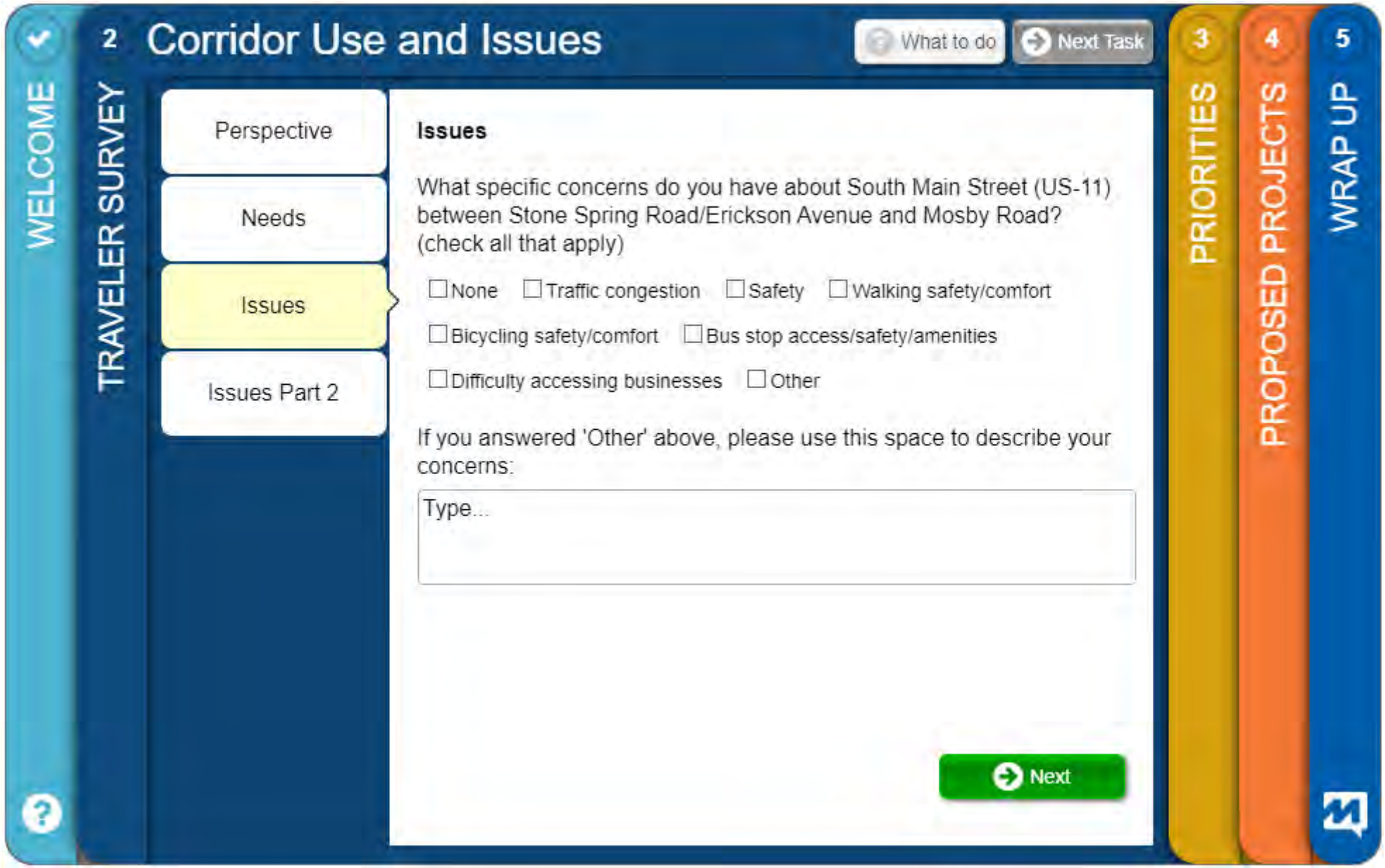
Survey Analysis: Corridor Use & Issues

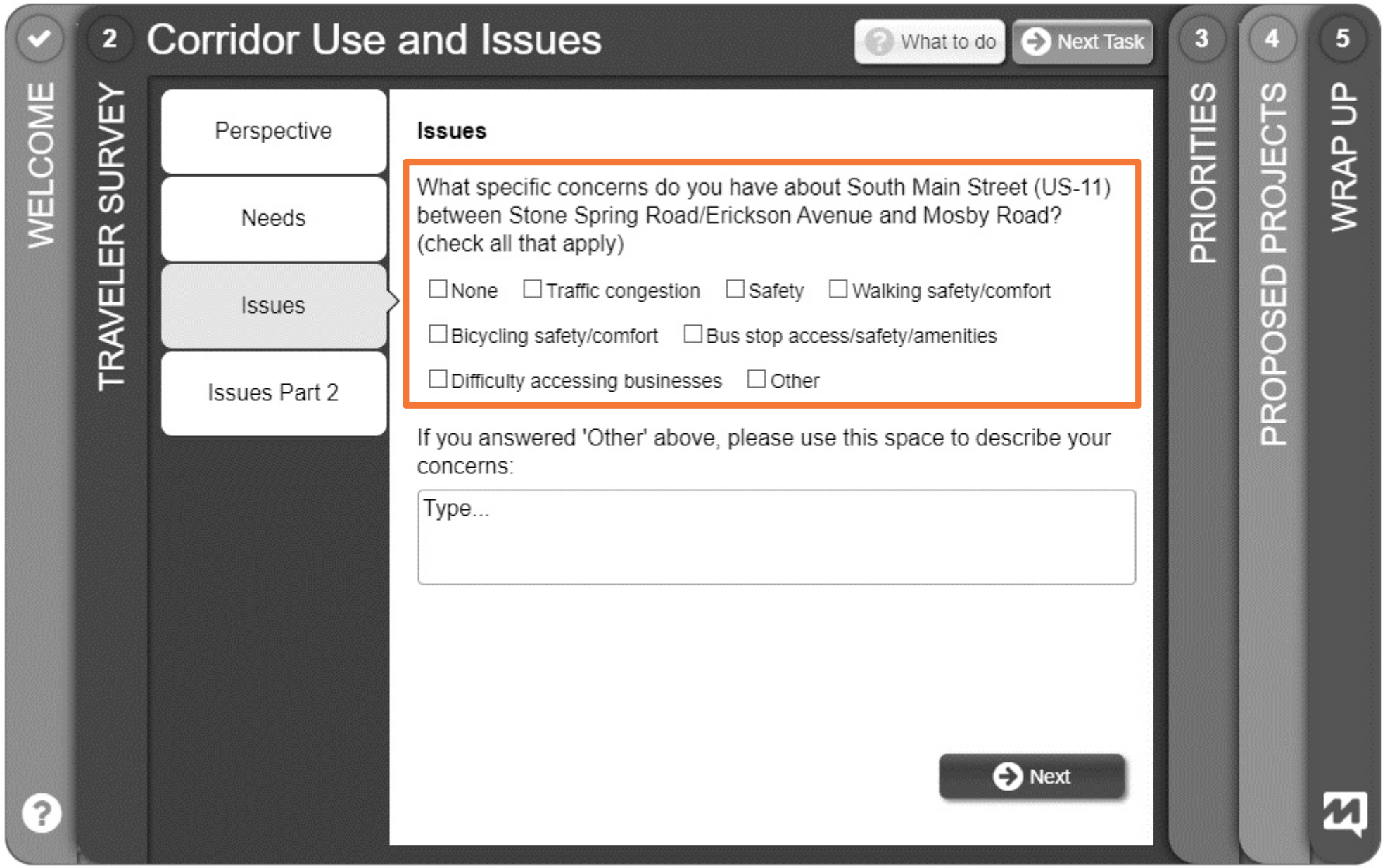

WELCOME
TRAVELER SURVEY
2 Corridor Use and Issues
What to do
Next Task
Perspective
Needs
Issues
Issues Part 2
Perspective
What is your primary perspective as a user of South Main Street and/or Erickson Avenue?
Commuter/through traveler
Business customer or employee
Non-motorized (walking or biking)
Property owner or business manager
Other
What mode(s) of transportation do you typically use on South Main Street and/or Erickson Avenue? (check all that apply)
Passenger vehicle
Bus
Walk
Bicycle
Commercial vehicle
Other
Next
3 PRIORITIES
4 PROPOSED PROJECTS
5 WRAP UP


WELCOME
TRAVELER SURVEY
2
Corridor Use and Issues
What to do
Next Task
3
PRIORITIES
4
PROPOSED PROJECTS
5
WRAP UP
Perspective
Needs
Issues
Issues Part 2
Perspective
What is your primary perspective as a user of South Main Street and/or Erickson Avenue?
Commuter/through traveler 73%
Business customer or employee 2%
Non-motorized (walking or biking) 2%
Property owner or business manager 4%
Other 19%
What mode(s) of transportation do you typically use on South Main Street and/or Erickson Avenue? (check all that apply)
Passenger vehicle #1 (85%)
Bus #5 (1%)
Walk #4 (3%)
Bicycle #3 (4%)
Commercial vehicle #2 (6%)
Other #6 (1%)
Next

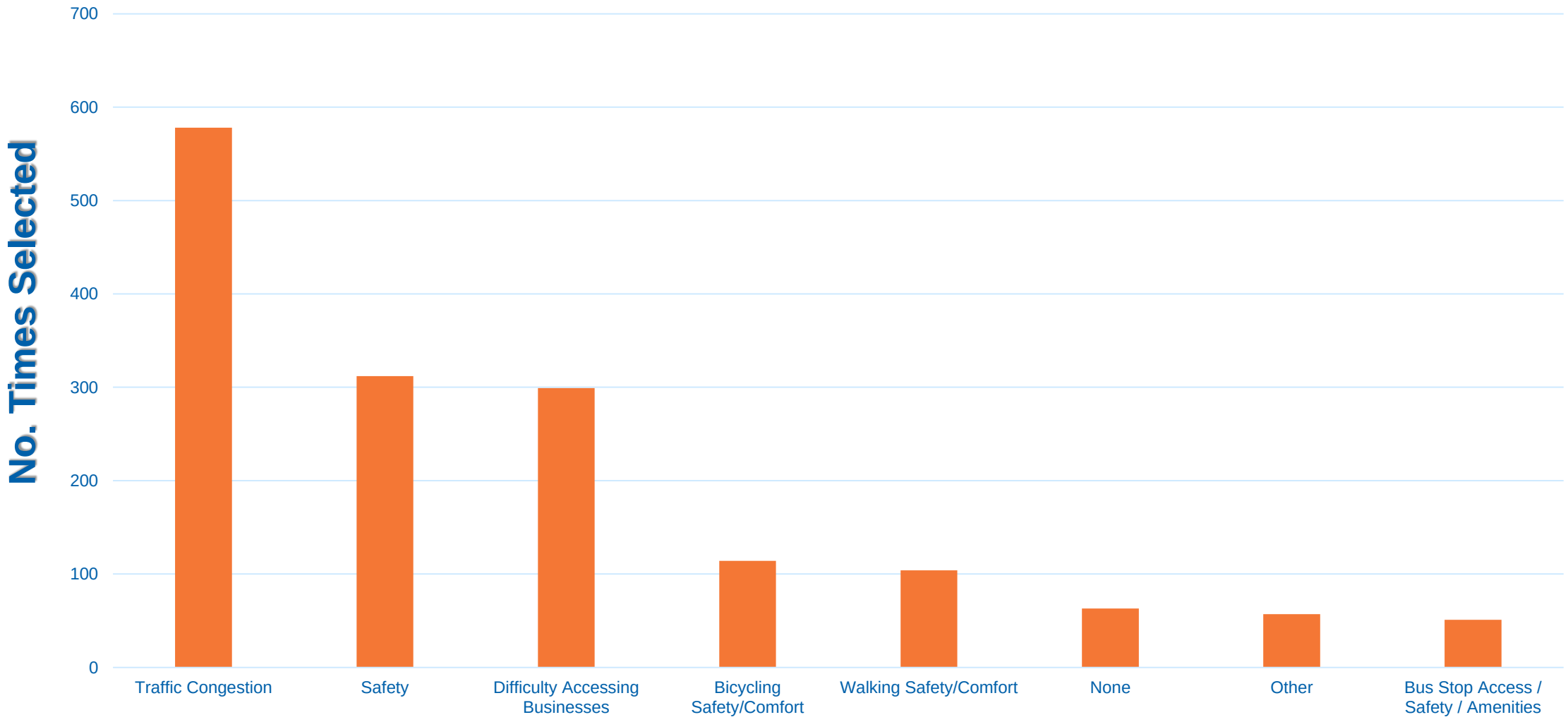

WELCOME
TRAVELER SURVEY
2
Corridor Use and Issues
What to do
Next Task
Perspective
Needs
Issues
Issues Part 2
Needs
From your perspective, are changes needed to improve travel conditions on South Main Street (US-11) between Stone Spring Road/Erickson Avenue and Mosby Road?
Yes
No
Neutral / Not sure
From your perspective, are changes needed to improve travel conditions at the intersection of Erickson Avenue & Pear Street?
Yes
No
Neutral / Not sure
Next
3
PRIORITIES
4
PROPOSED PROJECTS
5
WRAP UP

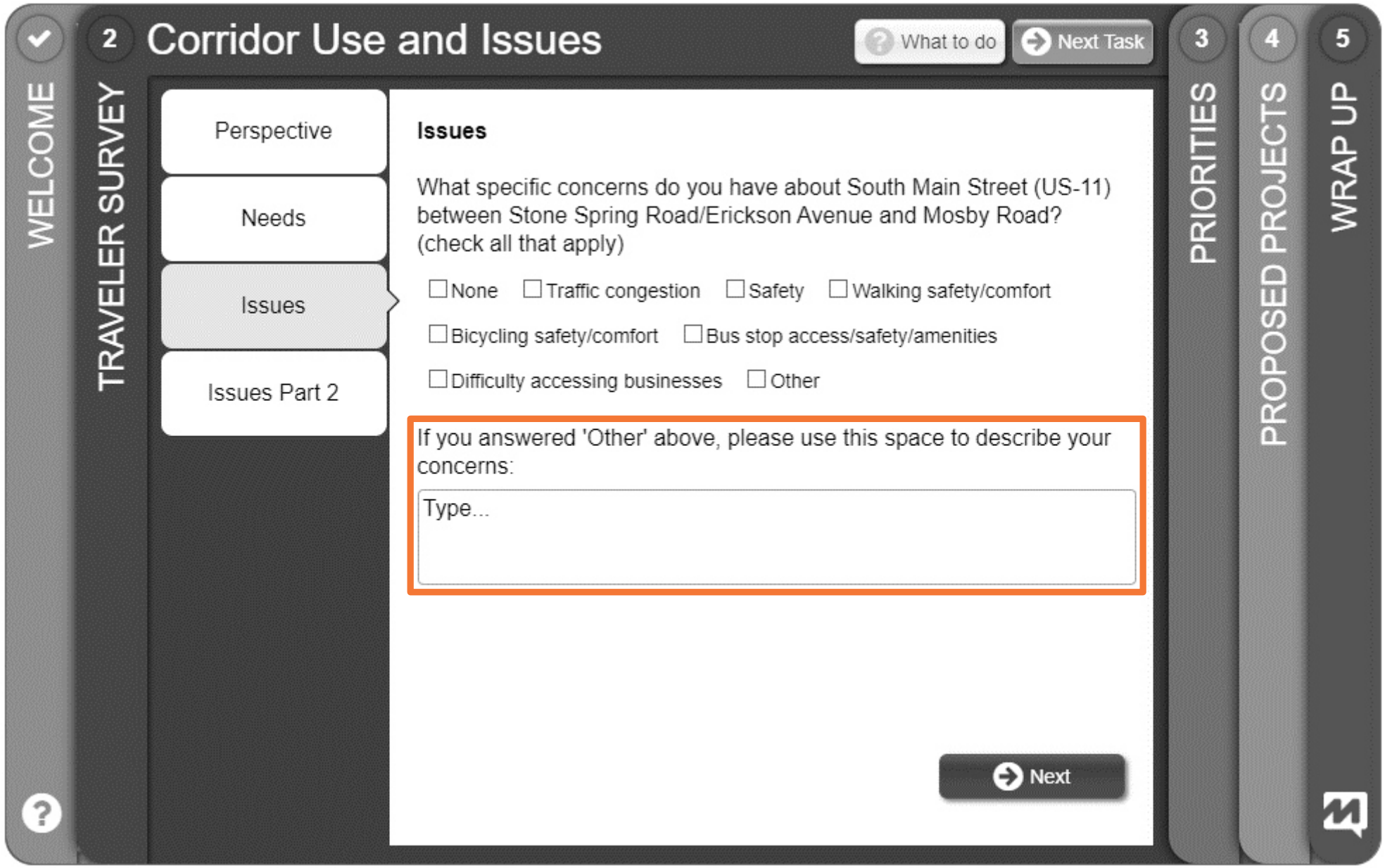

WELCOME
TRAVELER SURVEY
2
Corridor Use and Issues
What to do
Next Task
3
PRIORITIES
4
PROPOSED PROJECTS
5
WRAP UP
Perspective
Needs
Issues
Issues Part 2
Needs
From your perspective, are changes needed to improve travel conditions on South Main Street (US-11) between Stone Spring Road/Erickson Avenue and Mosby Road?
64%
16%
20%
From your perspective, are changes needed to improve travel conditions at the intersection of Erickson Avenue & Pear Street?
70%
12%
18%
Next


WELCOME
TRAVELER SURVEY
2 Corridor Use and Issues
What to do
Next Task
Perspective
Needs
Issues
Issues Part 2
Issues
What specific concerns do you have about South Main Street (US-11) between Stone Spring Road/Erickson Avenue and Mosby Road? (check all that apply)
None
Traffic congestion
Safety
Walking safety/comfort
Bicycling safety/comfort
Bus stop access/safety/amenities
Difficulty accessing businesses
Other
If you answered 'Other' above, please use this space to describe your concerns:
Type...
Next
3 PRIORITIES
4 PROPOSED PROJECTS
5 WRAP UP


WELCOME
2
Corridor Use and Issues
What to do
Next Task
3
PRIORITIES
4
PROPOSED PROJECTS
5
WRAP UP
TRAVELER SURVEY
Perspective
Needs
Issues
Issues Part 2
Issues
What specific concerns do you have about South Main Street (US-11) between Stone Spring Road/Erickson Avenue and Mosby Road? (check all that apply)
None
Traffic congestion
Safety
Walking safety/comfort
Bicycling safety/comfort
Bus stop access/safety/amenities
Difficulty accessing businesses
Other
If you answered 'Other' above, please use this space to describe your concerns:
Type...
Next

What specific concerns do you have about S. Main St. (US-11) between Stone Spring Rd. / Erickson Ave. & Mosby Rd.?




WELCOME
TRAVELER SURVEY
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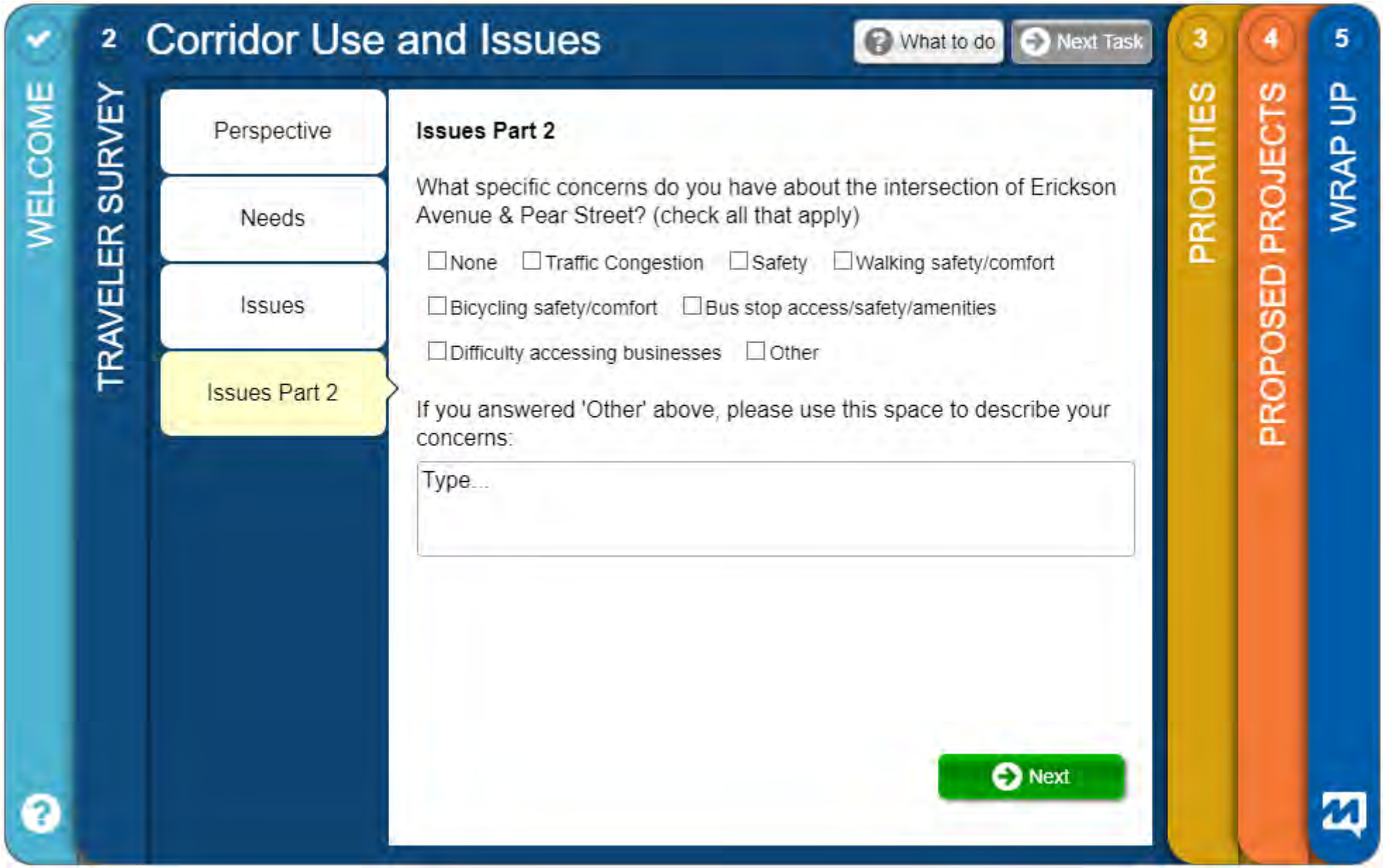
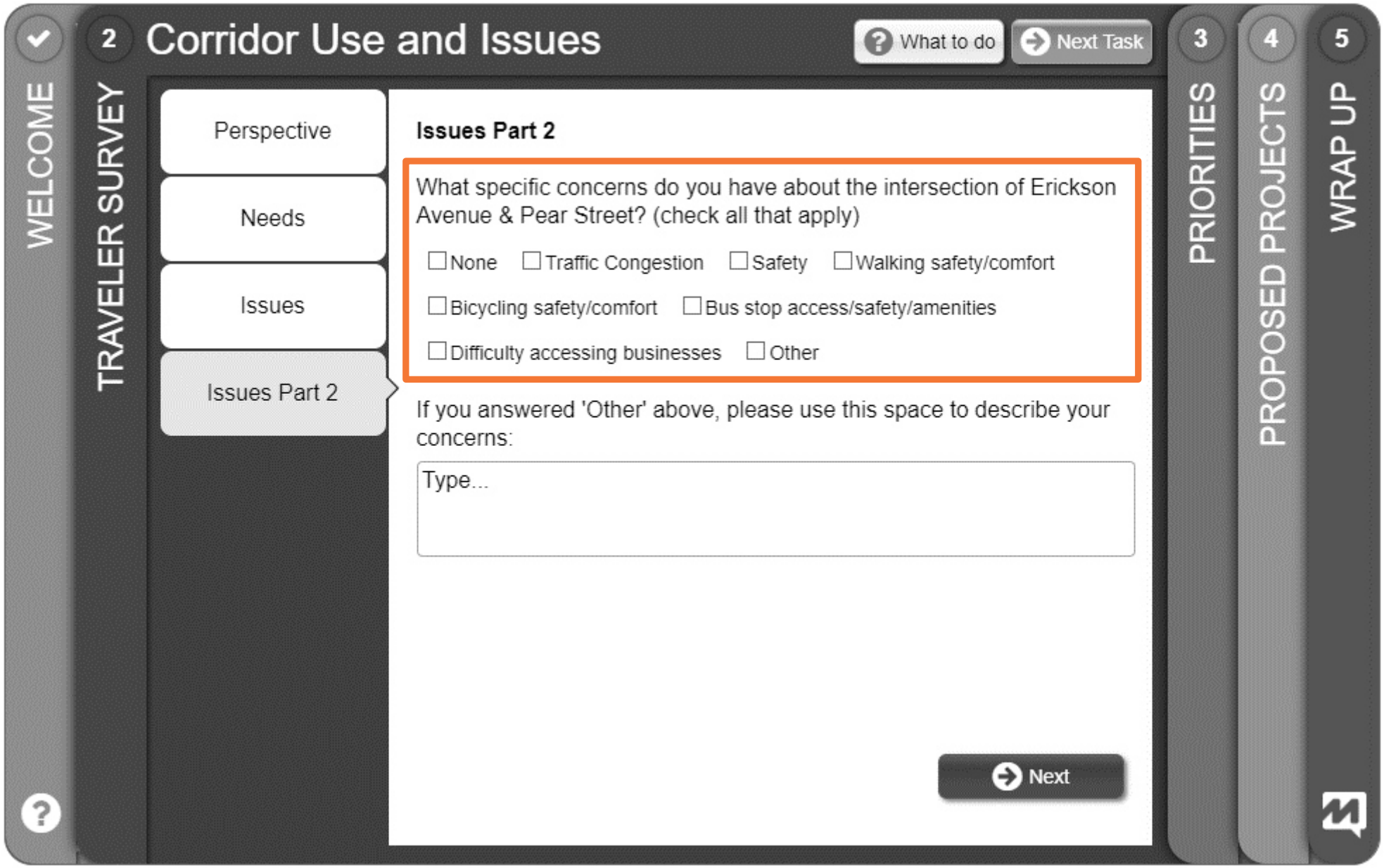
Corridor Use and Issues
What to do
Next Task
Perspective
Needs
Issues
Issues Part 2
Issues
What specific concerns do you have about South Main Street (US-11) between Stone Spring Road/Erickson Avenue and Mosby Road? (check all that apply)
None
Traffic congestion
Safety
Walking safety/comfort
Bicycling safety/comfort
Bus stop access/safety/amenities
Difficulty accessing businesses
Other
If you answered 'Other' above, please use this space to describe your concerns:
Type...
Next
3
PRIORITIES
4
PROPOSED PROJECTS
5
WRAP UP

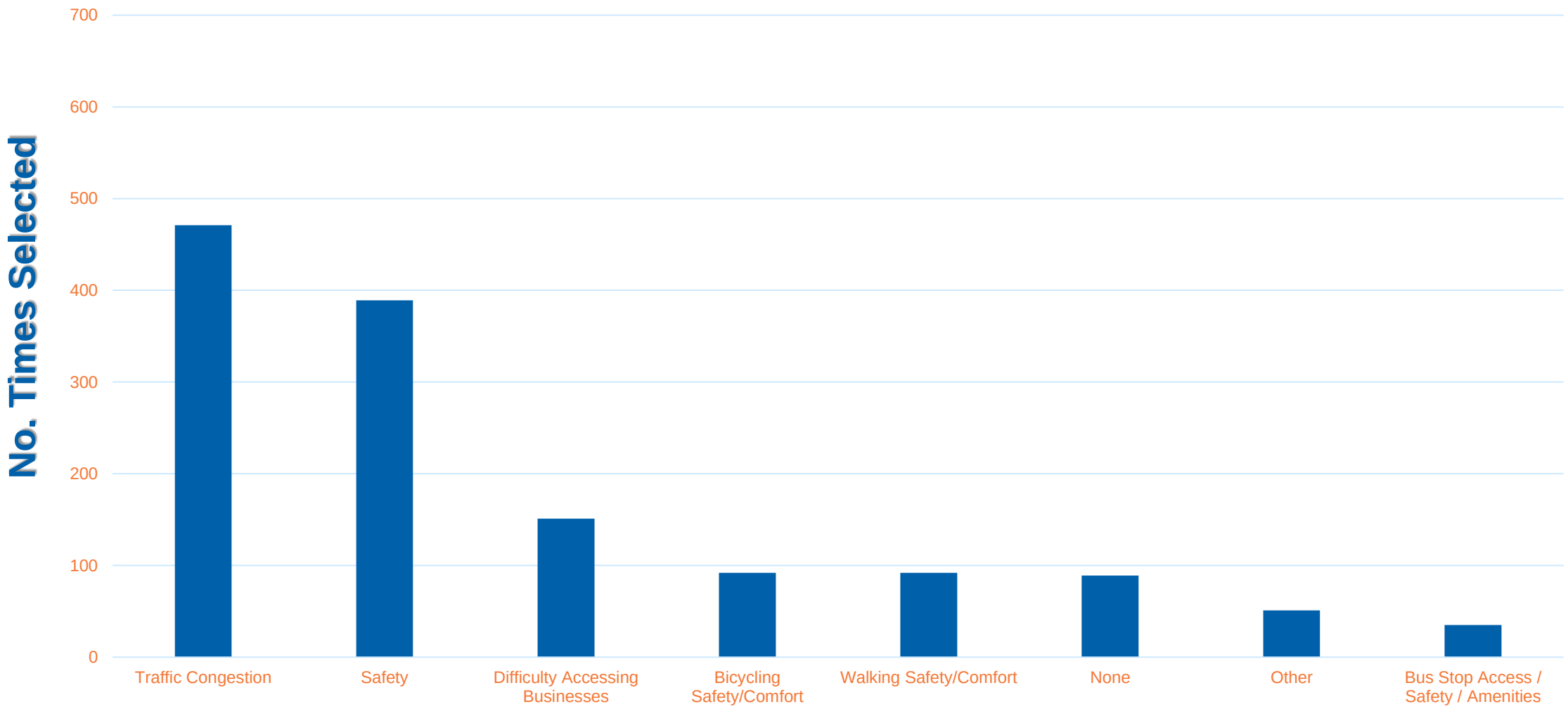
Sample Comments:

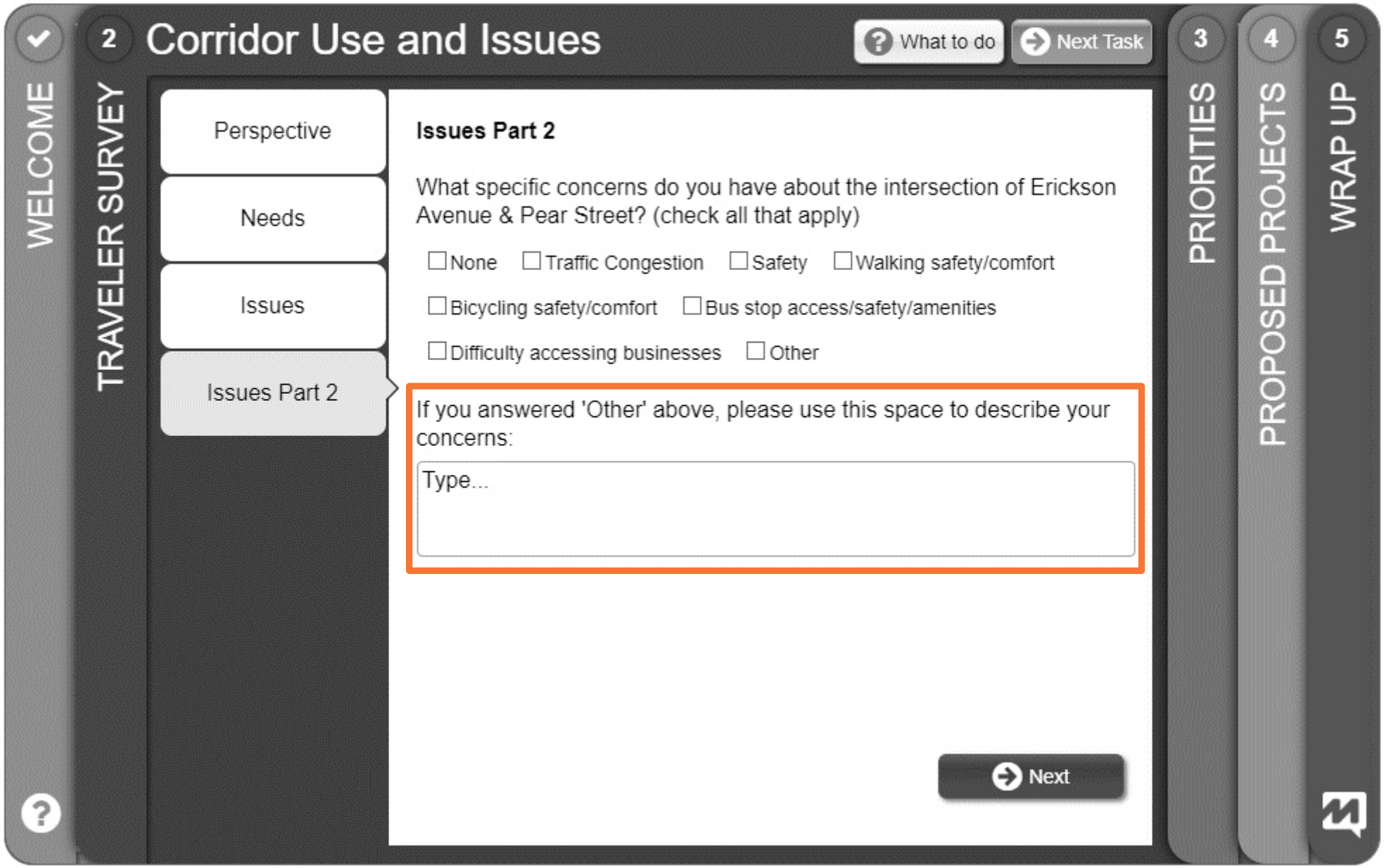
- *"People waving drivers through and they get T-boned…"*
- *"I have personally been in an accident at S. Main and E. Mosby. There should be NO LEFT turns for cars pulling out of the McDonald's/Burger King…"*
- *"Too much traffic trying to access the fast food restaurants and visa-versa between two busy intersections…"*
- *"Huge volume of people speeding. Always…"*
- *"New school only adds to overcrowded road. When I-81 is down it is a mess…"*
- *"I live off of S. Main and cannot safely exit my street due to congestion with no stop light…"*


WELCOME
2
TRAVELER SURVEY
Corridor Use and Issues
What to do
Next Task
Perspective
Needs
Issues
Issues Part 2
Issues Part 2
What specific concerns do you have about the intersection of Erickson Avenue & Pear Street? (check all that apply)
None
Traffic Congestion
Safety
Walking safety/comfort
Bicycling safety/comfort
Bus stop access/safety/amenities
Difficulty accessing businesses
Other
If you answered 'Other' above, please use this space to describe your concerns:
Type...
Next
3
PRIORITIES
4
PROPOSED PROJECTS
5
WRAP UP


WELCOME
2
Corridor Use and Issues
What to do
Next Task
3
PRIORITIES
4
PROPOSED PROJECTS
5
WRAP UP
TRAVELER SURVEY
Perspective
Needs
Issues
Issues Part 2
Issues Part 2
What specific concerns do you have about the intersection of Erickson Avenue & Pear Street? (check all that apply)
None
Traffic Congestion
Safety
Walking safety/comfort
Bicycling safety/comfort
Bus stop access/safety/amenities
Difficulty accessing businesses
Other
If you answered 'Other' above, please use this space to describe your concerns:
Type...
Next

What specific concerns do you have about the intersection of Erickson Ave. & Pear St.?




WELCOME
2
Corridor Use and Issues
What to do
Next Task
3
4
5
TRAVELER SURVEY
PRIORITIES
PROPOSED PROJECTS
WRAP UP
Perspective
Needs
Issues
Issues Part 2
Issues Part 2
What specific concerns do you have about the intersection of Erickson Avenue & Pear Street? (check all that apply)
None
Traffic Congestion
Safety
Walking safety/comfort
Bicycling safety/comfort
Bus stop access/safety/amenities
Difficulty accessing businesses
Other
If you answered 'Other' above, please use this space to describe your concerns:
Type...
Next

Sample Comments:

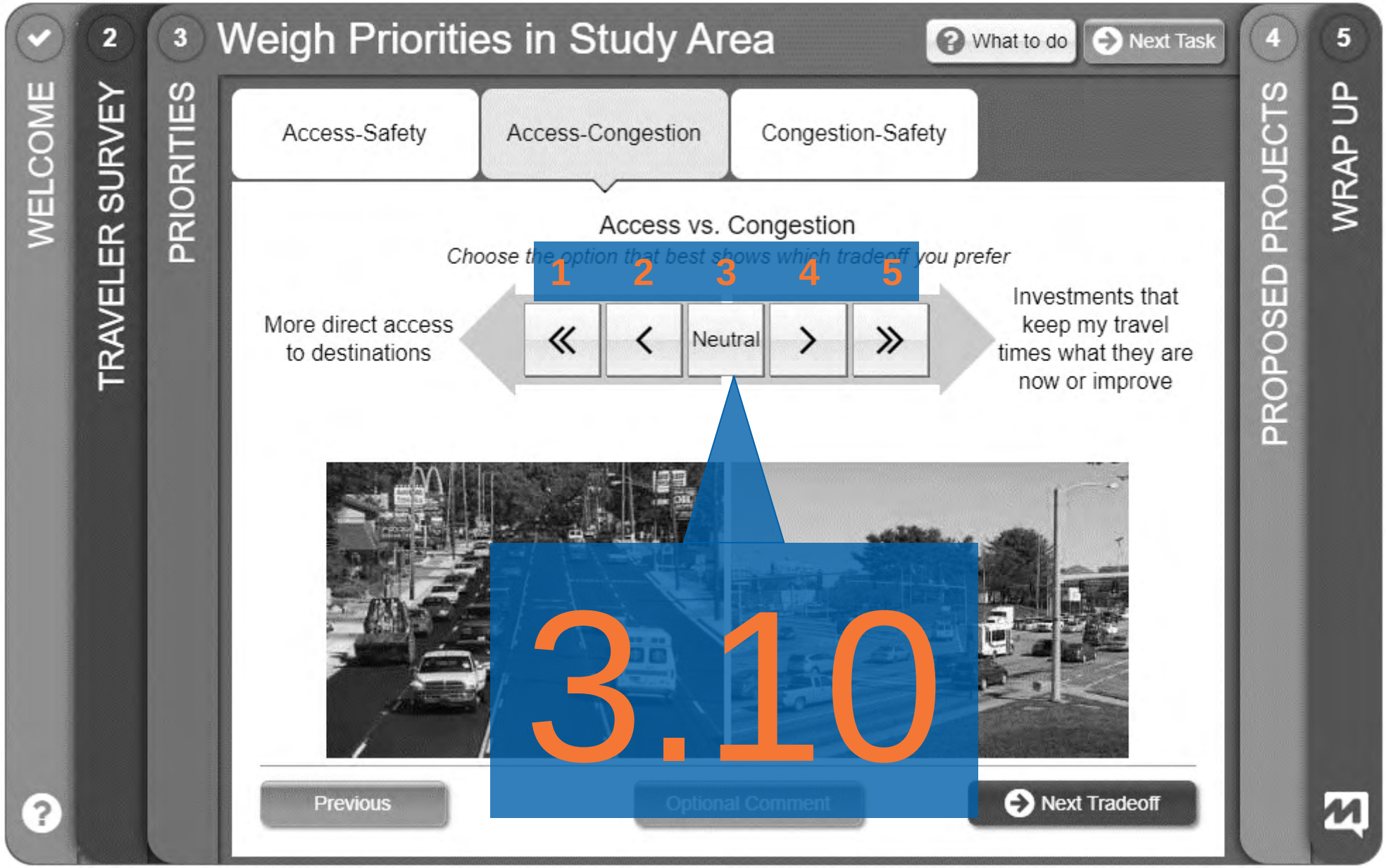
- *"Concern about the complication with the railroad tracks present. It seems some drivers are unsure of right of way, where to stop, or when to go…"*
- *"Entering the Pear intersection is not for the faint hearted. Very dangerous…"*
- *"Cannot turn left on at peak commuter times from Pear to Erickson…"*
- *"Left turns from Pear onto Erickson are becoming increasingly difficult…"*
- *"I've reported two separate accidents that I've seen happen in this intersection. It can take five minutes some days to get across the Erickson intersection from Pear Street…"*

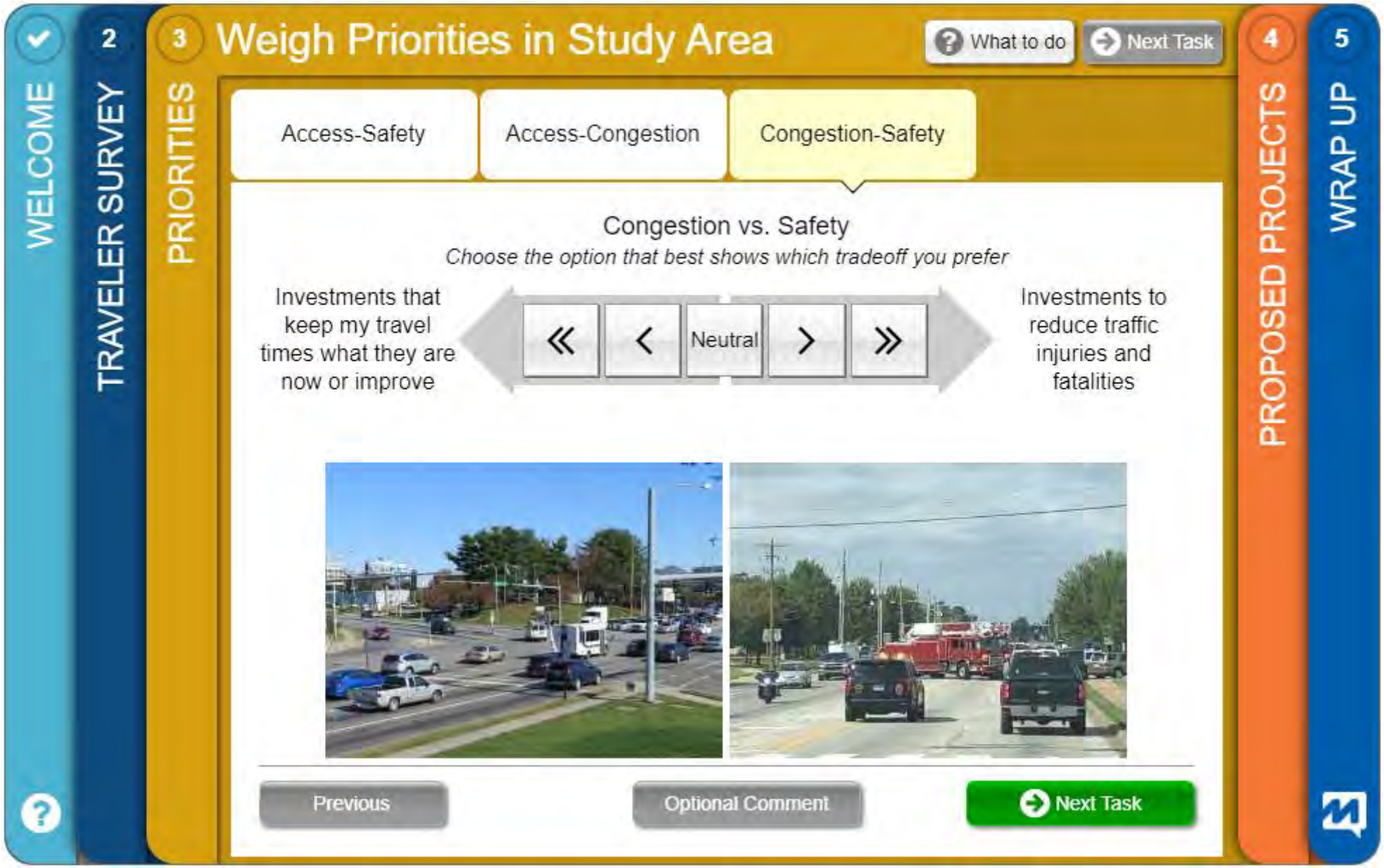
Survey Analysis: Corridor Priorities

WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
Weigh Priorities in Study Area
What to do
Next Task
Access-Safety
Access-Congestion
Congestion-Safety
Access vs. Safety
Choose the option that best shows which tradeoff you prefer
More direct access to destinations
Neutral
Investments to reduce traffic injuries and fatalities
Previous
Optional Comment
Next Tradeoff
4
PROPOSED PROJECTS
5
WRAP UP

WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
Weigh Priorities in Study Area
What to do
Next Task
4
PROPOSED PROJECTS
5
WRAP UP
Access-Safety
Access-Congestion
Congestion-Safety
Access vs. Safety
Choose the option that best shows which tradeoff you prefer
1
2
3
4
5
More direct access to destinations
Neutral
Investments to reduce traffic injuries and fatalities
3.11
Previous
Optional Comment
Next Tradeoff

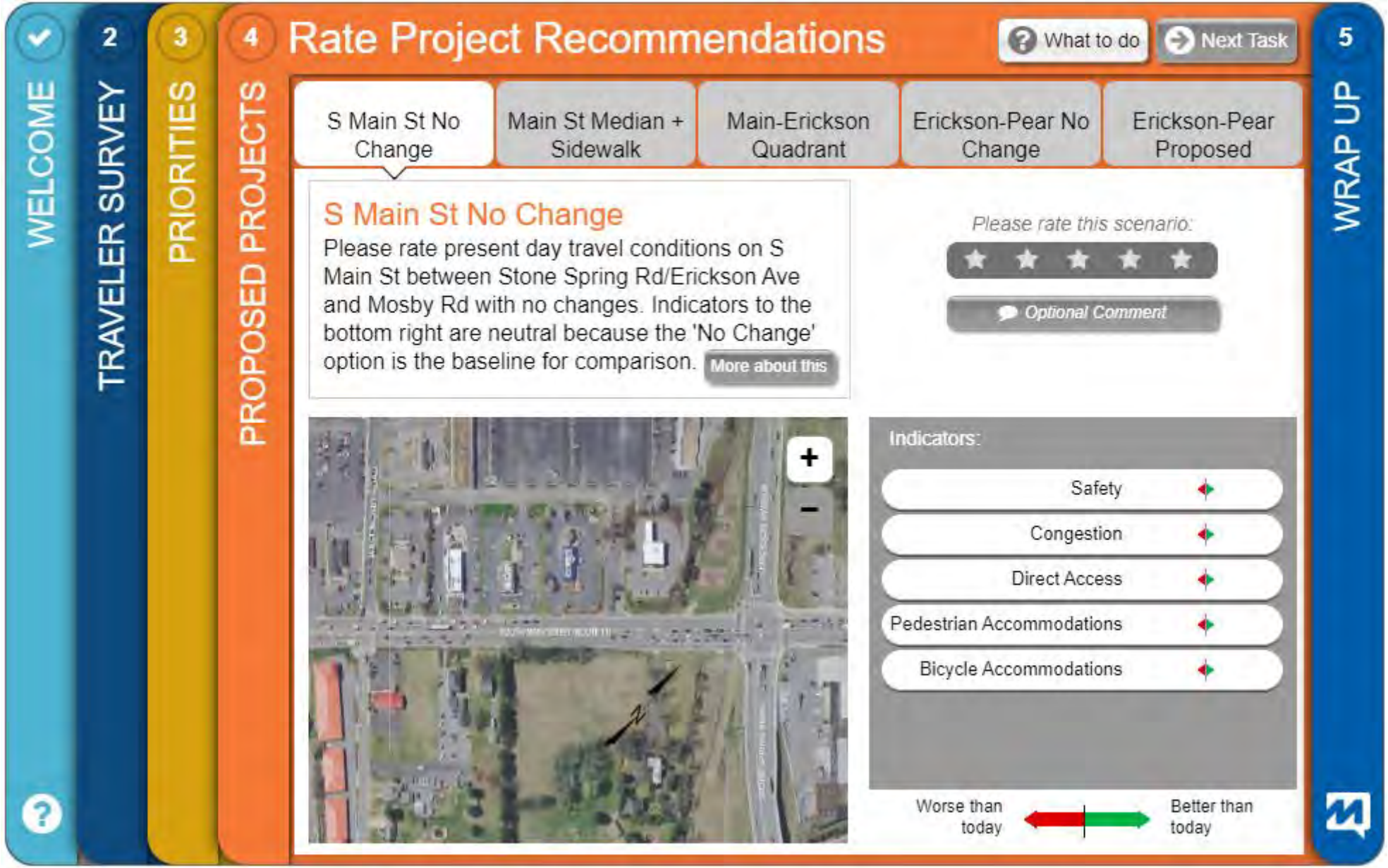
WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
Weigh Priorities in Study Area
What to do
Next Task
4
PROPOSED PROJECTS
5
WRAP UP
Access-Safety
Access-Congestion
Congestion-Safety
Access vs. Congestion
Choose the option that best shows which tradeoff you prefer
More direct access to destinations
Neutral
Investments that keep my travel times what they are now or improve
Previous
Optional Comment
Next Tradeoff

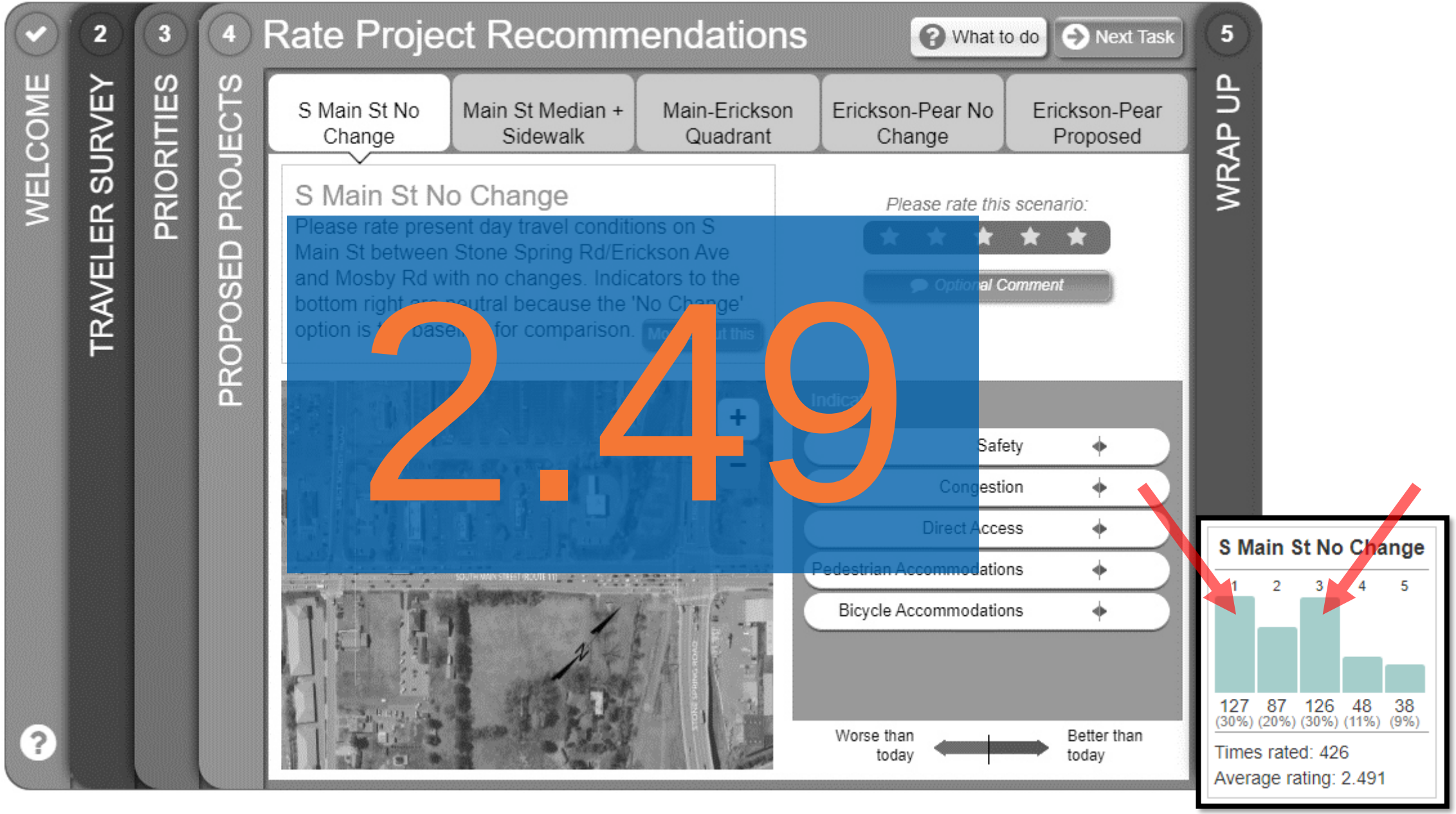

WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
Weigh Priorities in Study Area
What to do
Next Task
4
PROPOSED PROJECTS
5
WRAP UP
Access-Safety
Access-Congestion
Congestion-Safety
Access vs. Congestion
Choose the option that best shows which tradeoff you prefer
1
2
3
4
5
More direct access to destinations
Neutral
Investments that keep my travel times what they are now or improve
3.10
Previous
Optional Comment
Next Tradeoff

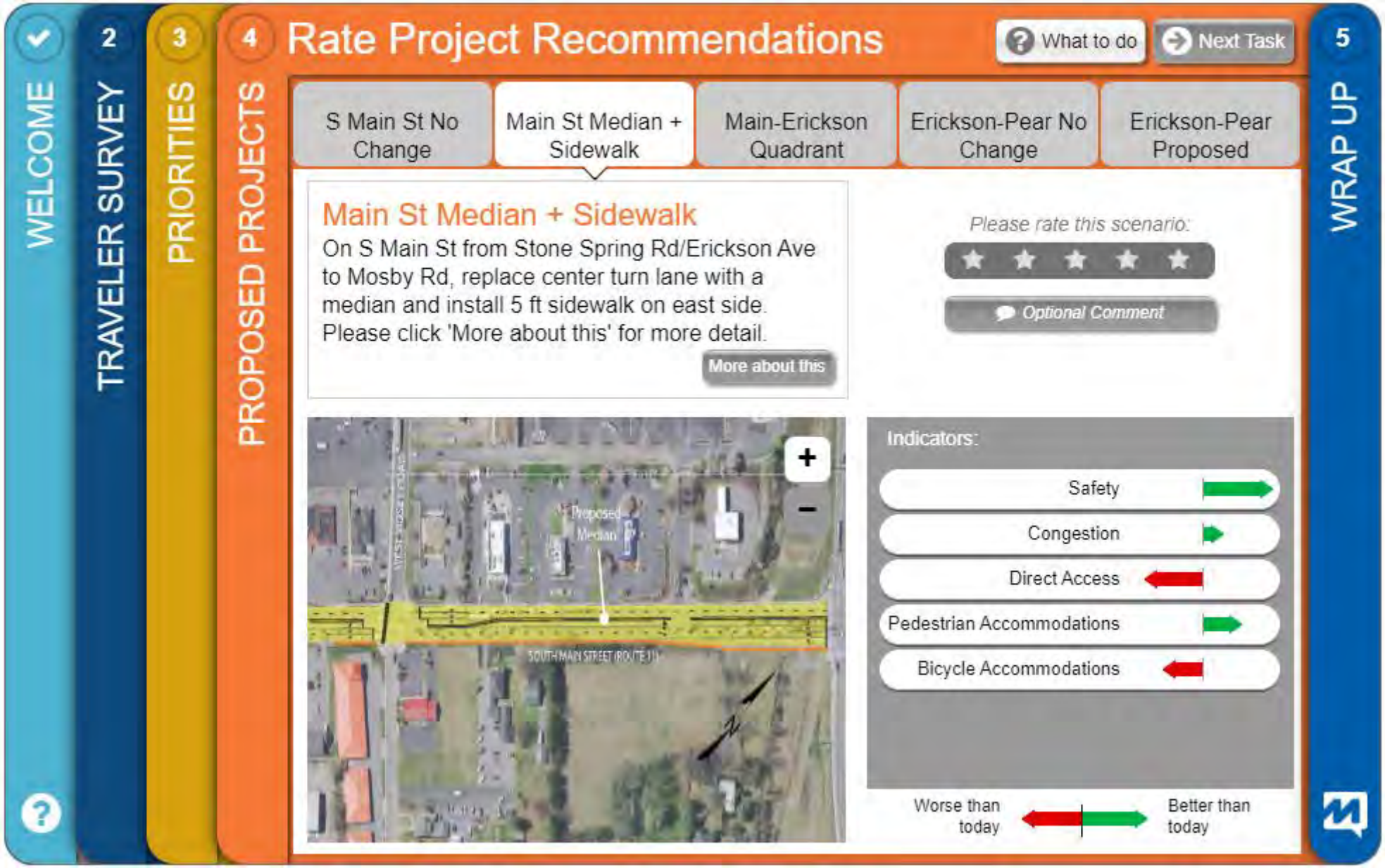

WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
Weigh Priorities in Study Area
What to do
Next Task
Access-Safety
Access-Congestion
Congestion-Safety
Congestion vs. Safety
Choose the option that best shows which tradeoff you prefer
Investments that keep my travel times what they are now or improve
Neutral
Investments to reduce traffic injuries and fatalities
Previous
Optional Comment
Next Task
4
PROPOSED PROJECTS
5
WRAP UP

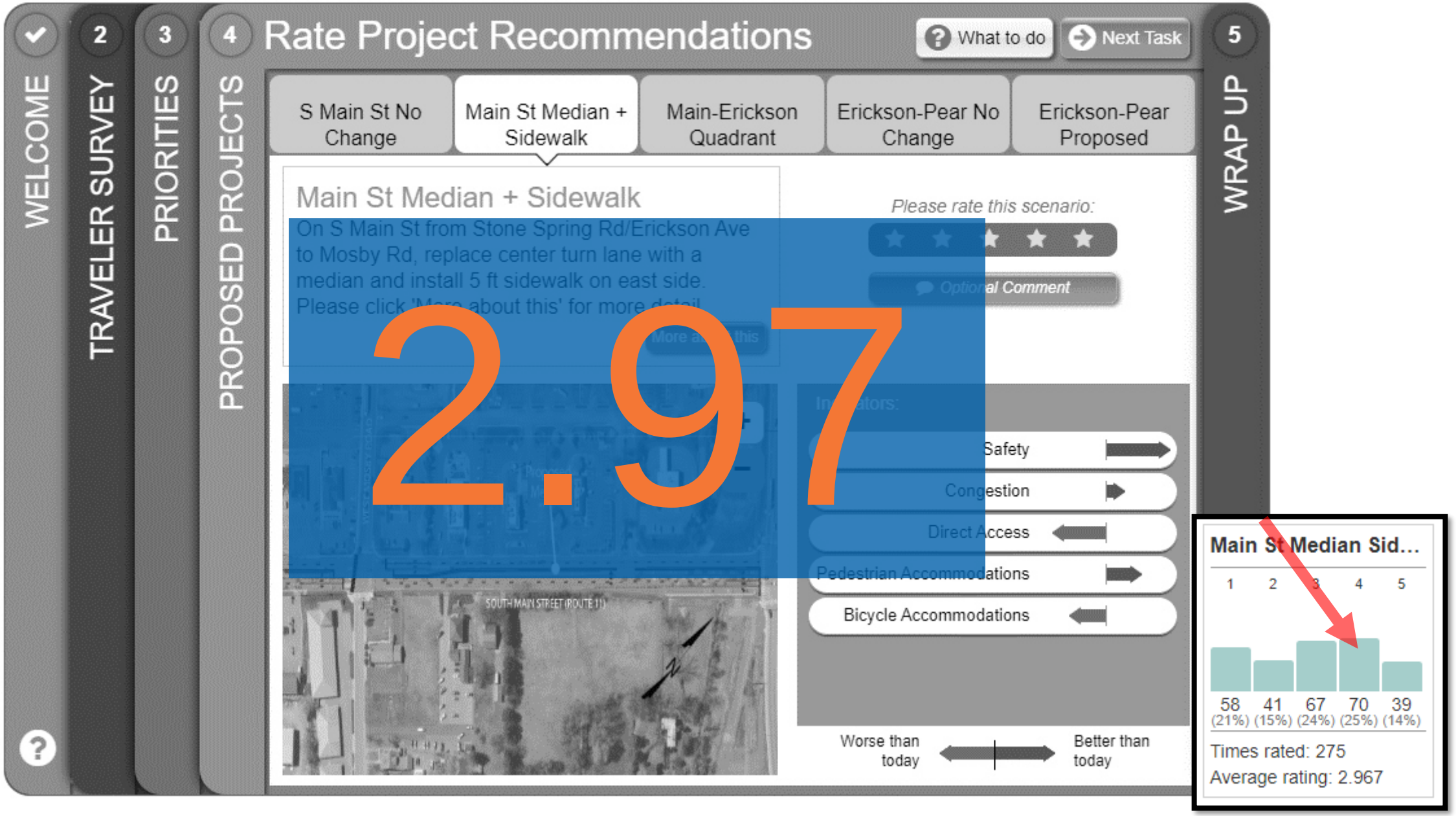
WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
Weigh Priorities in Study Area
What to do
Next Task
4
PROPOSED PROJECTS
5
WRAP UP
Access-Safety
Access-Congestion
Congestion-Safety
Congestion vs. Safety
Choose the option that best shows which tradeoff you prefer
1
2
3
4
5
Investments that keep my travel times what they are now or improve
Neutral
Investments to reduce traffic injuries and fatalities
3.09
Previous
Optional Comment
Next Task

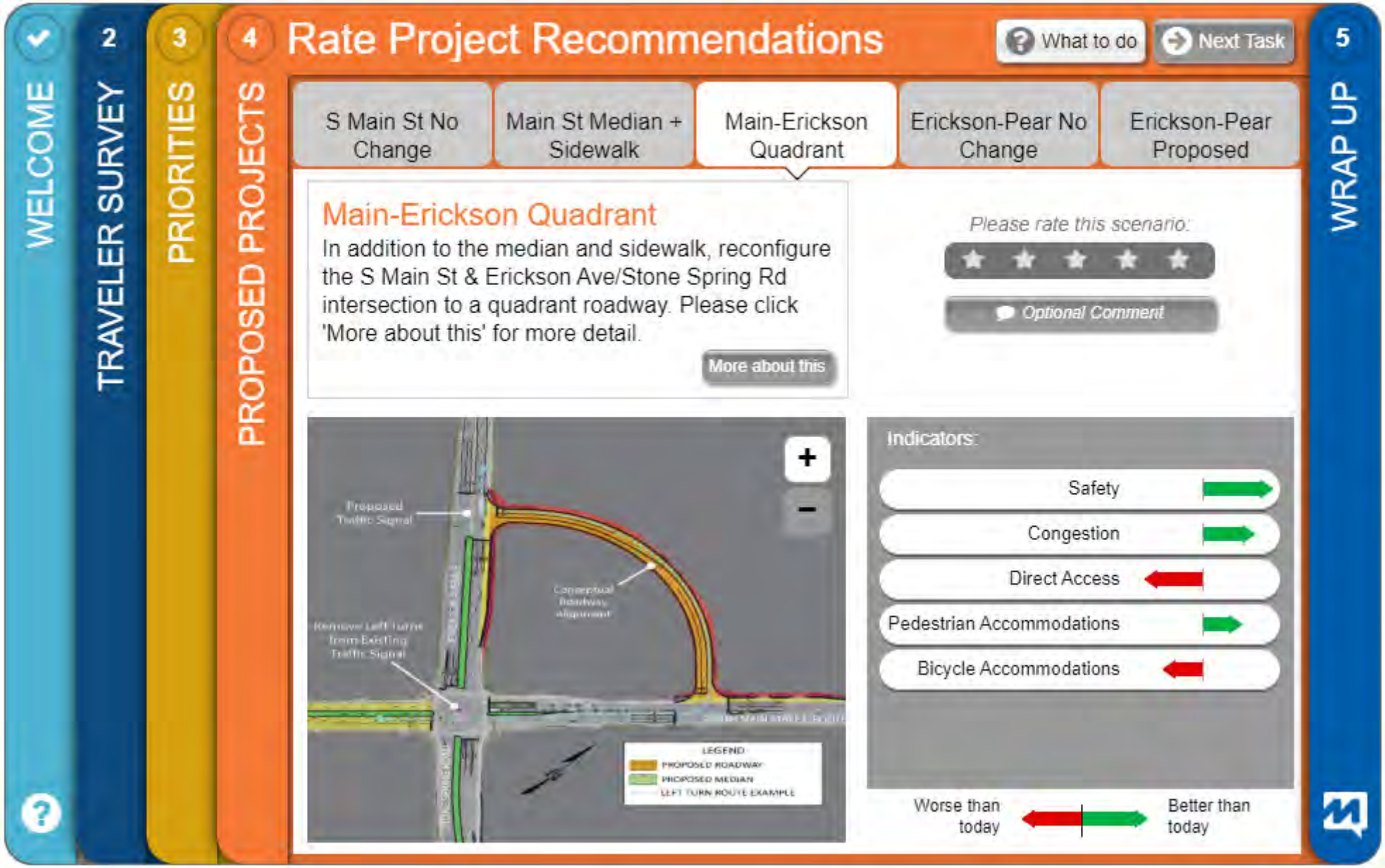
Survey Analysis:
Alternatives Survey (S. Main)


WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
Rate Project Recommendations
What to do
Next Task
5
WRAP UP
S Main St No Change
Main St Median + Sidewalk
Main-Erickson Quadrant
Erickson-Pear No Change
Erickson-Pear Proposed
S Main St No Change
Please rate present day travel conditions on S Main St between Stone Spring Rd/Erickson Ave and Mosby Rd with no changes. Indicators to the bottom right are neutral because the 'No Change' option is the baseline for comparison.
More about this
Please rate this scenario:
Optional Comment
Indicators:
Safety
Congestion
Direct Access
Pedestrian Accommodations
Bicycle Accommodations
Worse than today
Better than today

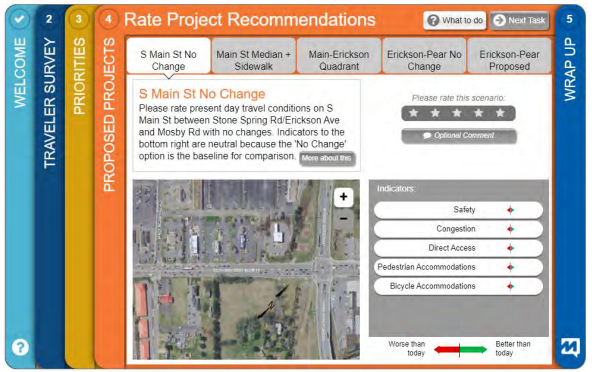

WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
Rate Project Recommendations
What to do
Next Task
5
WRAP UP
S Main St No Change
Main St Median + Sidewalk
Main-Erickson Quadrant
Erickson-Pear No Change
Erickson-Pear Proposed
S Main St No Change
Please rate present day travel conditions on S Main St between Stone Spring Rd/Erickson Ave and Mosby Rd with no changes. Indicators to the bottom right are neutral because the 'No Change' option is the baseline for comparison.
Please rate this scenario:
Optional Comment
2.49
Safety
Congestion
Direct Access
Pedestrian Accommodations
Bicycle Accommodations
Worse than today
Better than today
S Main St No Change
1 2 3 4 5
127 (30%) 87 (20%) 126 (30%) 48 (11%) 38 (9%)
Times rated: 426
Average rating: 2.491


WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
Rate Project Recommendations
What to do
Next Task
5
WRAP UP
S Main St No Change
Main St Median + Sidewalk
Main-Erickson Quadrant
Erickson-Pear No Change
Erickson-Pear Proposed
Main St Median + Sidewalk
On S Main St from Stone Spring Rd/Erickson Ave to Mosby Rd, replace center turn lane with a median and install 5 ft sidewalk on east side. Please click 'More about this' for more detail.
More about this
Please rate this scenario:
Optional Comment
Proposed Median
SOUTH MAIN STREET (ROUTE 11)
Indicators:
Safety
Congestion
Direct Access
Pedestrian Accommodations
Bicycle Accommodations
Worse than today
Better than today


WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
Rate Project Recommendations
What to do
Next Task
5
WRAP UP
S Main St No Change
Main St Median + Sidewalk
Main-Erickson Quadrant
Erickson-Pear No Change
Erickson-Pear Proposed
Main St Median + Sidewalk
On S Main St from Stone Spring Rd/Erickson Ave to Mosby Rd, replace center turn lane with a median and install 5 ft sidewalk on east side.
Please click 'More about this' for more detail
Please rate this scenario:
Optional Comment
2.97
SOUTH MAIN STREET (ROUTE 11)
Safety
Congestion
Direct Access
Pedestrian Accommodations
Bicycle Accommodations
Worse than today
Better than today
Main St Median Sid...
1 2 3 4 5
58 (21%) 41 (15%) 67 (24%) 70 (25%) 39 (14%)
Times rated: 275
Average rating: 2.967

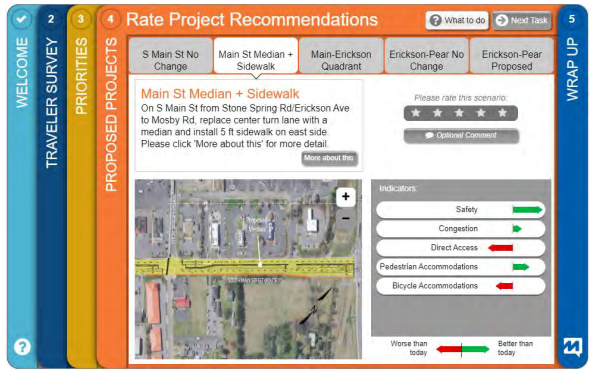

WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
Rate Project Recommendations
What to do
Next Task
5
WRAP UP
S Main St No Change
Main St Median + Sidewalk
Main-Erickson Quadrant
Erickson-Pear No Change
Erickson-Pear Proposed
Main-Erickson Quadrant
In addition to the median and sidewalk, reconfigure the S Main St & Erickson Ave/Stone Spring Rd intersection to a quadrant roadway. Please click 'More about this' for more detail.
More about this
Please rate this scenario:
Optional Comment
Proposed Traffic Signal
Conceptual Roadway Alignment
Remove Left Turns from Existing Traffic Signal
LEGEND
PROPOSED ROADWAY
PROPOSED MEDIAN
LEFT TURN ROUTE EXAMPLE
Indicators:
Safety
Congestion
Direct Access
Pedestrian Accommodations
Bicycle Accommodations
Worse than today
Better than today

WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
Rate Project Recommendations
What to do
Next Task
5
WRAP UP
S Main St No Change
Main St Median + Sidewalk
Main-Erickson Quadrant
Erickson-Pear No Change
Erickson-Pear Proposed
Main-Erickson Quadrant
In addition to the median and sidewalk, reconfigure the S Main St & Erickson Ave/Stone Spring Rd intersection to a quadrant roadway. Please click 'More about this' for more detail.
More about this
Please rate this scenario:
Optional Comment
2.58
Safety
Congestion
Direct Access
Pedestrian Accommodations
Bicycle Accommodations
Worse than today
Better than today
LEGEND
PROPOSED ROADWAY
PROPOSED MEDIAN
LEFT TURN ROUTE EXAMPLE
MainErickson Quad...
1 2 3 4 5
74 (31%) 53 (22%) 46 (19%) 38 (16%) 31 (13%)
Times rated: 242
Average rating: 2.583



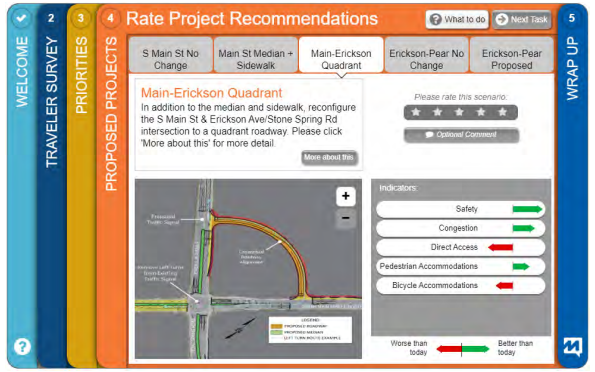
2.49

#1: No Change



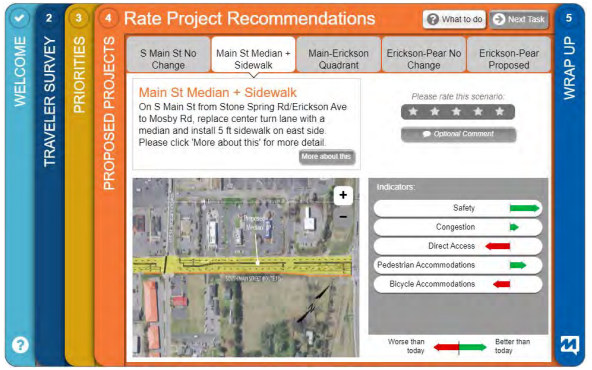
2.97

#2: Median & Sidewalk



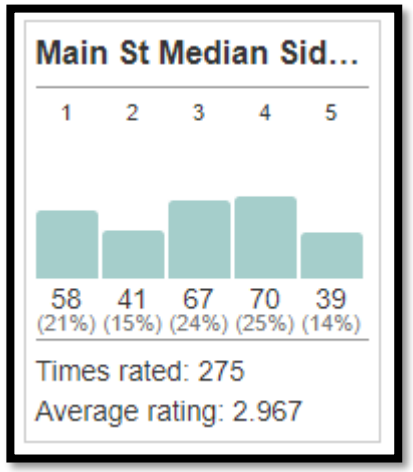
2.58

#3: Quadrant



2.97

#2: Median & Sidewalk



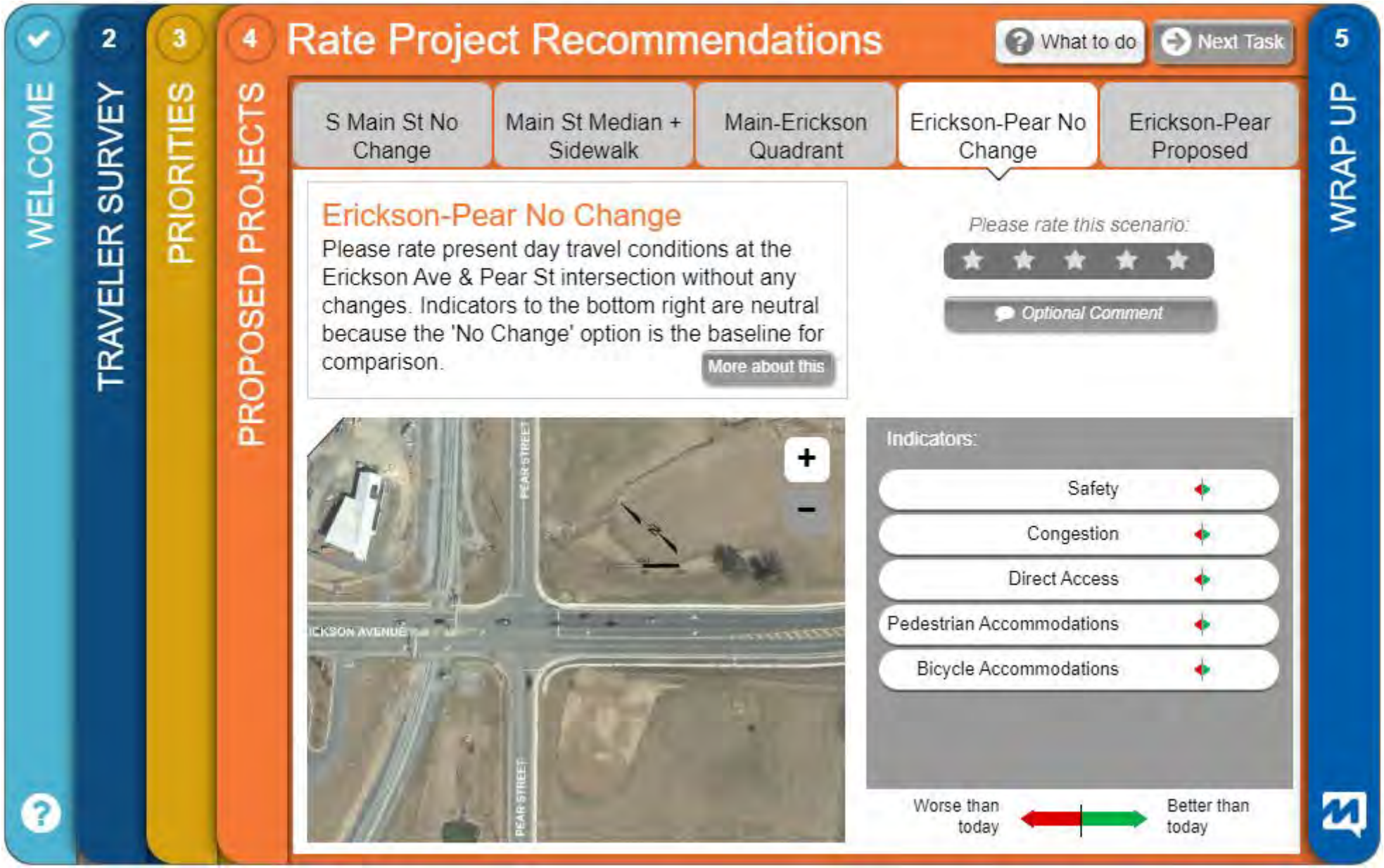
Survey comments in favor:

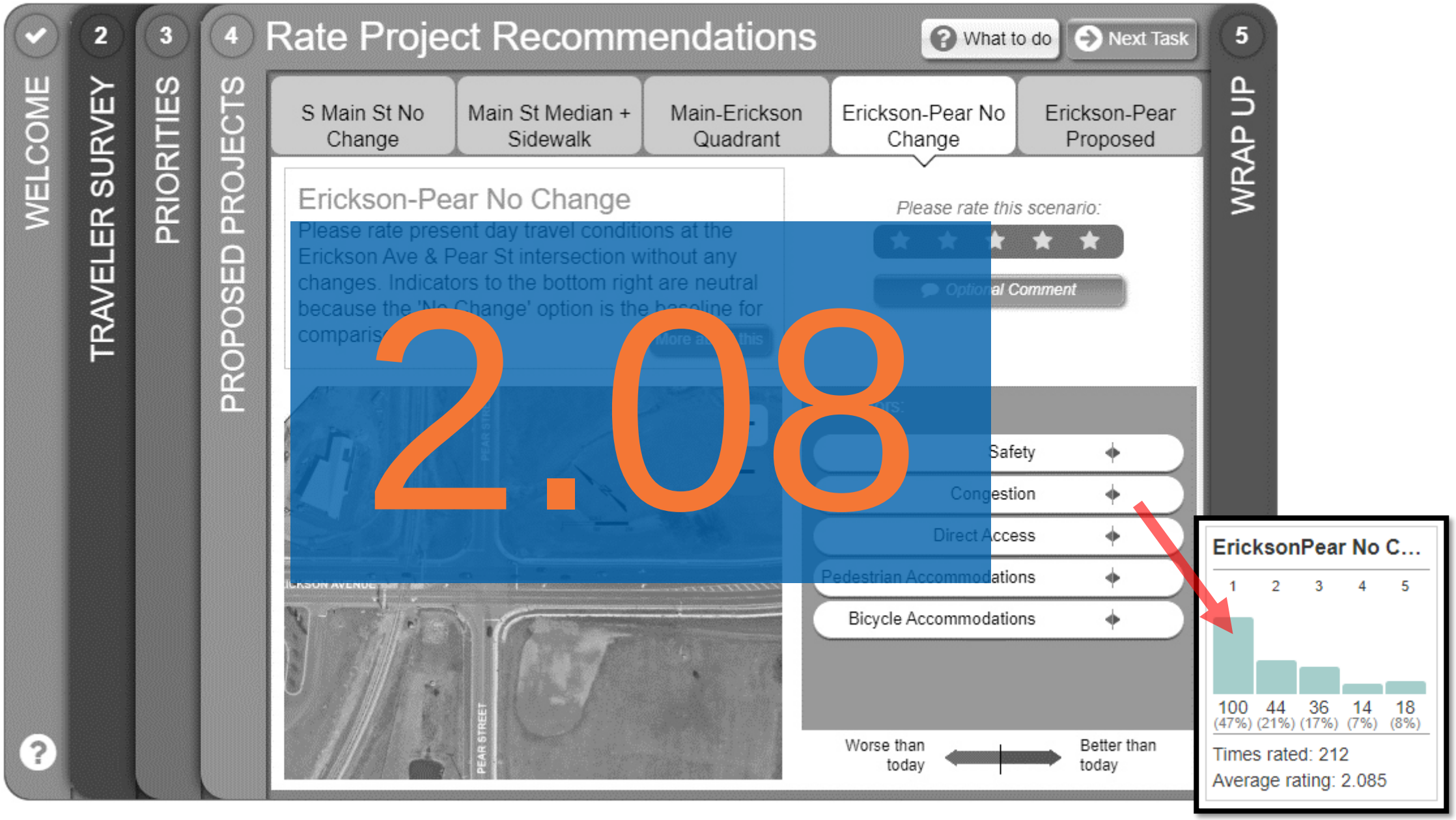
- *"Yes, please. This is the most direct way to change the huge safety hazard associated with this intersection."*
- *"This stretch is like a shooting gallery and my car is the duck. Please put in a median to reduce the different ways I can get hit."*
- *"This is a good idea but removing bike lanes is not the direction I think this should go."*
- *"Like the median but concerned with removing bike lanes."*

Survey comments in opposition:

- *"Where are the accommodations for bicycles? Can't you make the pedestrian and bicycle access the same?"*
- *"I can appreciate that the median would improve left hand turn accidents, but at the price of making it even more dangerous for cyclists? Nope, nope, nope."*
- *"That area is heavily trafficked by cyclist and removing bike lanes would increase the risks they face."*

Survey Analysis:
Alternatives Survey (Erickson/Pear)


WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
Rate Project Recommendations
What to do
Next Task
5
WRAP UP
S Main St No Change
Main St Median + Sidewalk
Main-Erickson Quadrant
Erickson-Pear No Change
Erickson-Pear Proposed
Erickson-Pear No Change
Please rate present day travel conditions at the Erickson Ave & Pear St intersection without any changes. Indicators to the bottom right are neutral because the 'No Change' option is the baseline for comparison.
More about this
Please rate this scenario:
Optional Comment
PEAR STREET
ICKSON AVENUE
PEAR STREET
Indicators:
Safety
Congestion
Direct Access
Pedestrian Accommodations
Bicycle Accommodations
Worse than today
Better than today


WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
Rate Project Recommendations
What to do
Next Task
5
WRAP UP
S Main St No Change
Main St Median + Sidewalk
Main-Erickson Quadrant
Erickson-Pear No Change
Erickson-Pear Proposed
Erickson-Pear No Change
Please rate present day travel conditions at the Erickson Ave & Pear St intersection without any changes. Indicators to the bottom right are neutral because the 'No Change' option is the baseline for comparis
Please rate this scenario:
Optional Comment
2.08
Safety
Congestion
Direct Access
Pedestrian Accommodations
Bicycle Accommodations
Worse than today
Better than today
EricksonPear No C...
1 2 3 4 5
100 (47%) 44 (21%) 36 (17%) 14 (7%) 18 (8%)
Times rated: 212
Average rating: 2.085

WELCOME

2 TRAVELER SURVEY

3 PRIORITIES

4 PROPOSED PROJECTS

Rate Project Recommendations

What to do | Next Task

5 WRAP UP

S Main St No Change | Main St Median + Sidewalk | Main-Erickson Quadrant | Erickson-Pear No Change | Erickson-Pear Proposed

Erickson-Pear Proposed

Reconfigure the Erickson Ave & Pear St intersection to restrict left turns and through movements off of Pear St onto Erickson Ave. Install traffic signal on Erickson Ave to the east for U-Turns.

More about this

Please rate this scenario:

★ ★ ★ ★ ★

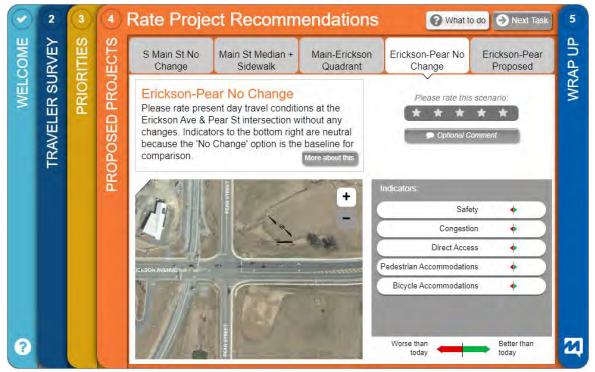
Optional Comment

Indicators:

- Safety
- Congestion
- Direct Access
- Pedestrian Accommodations
- Bicycle Accommodations

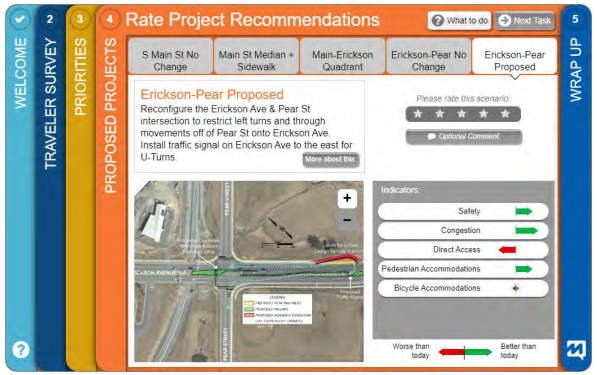
Worse than today ← → Better than today

WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
Rate Project Recommendations
What to do
Next Task
5
WRAP UP
S Main St No Change
Main St Median + Sidewalk
Main-Erickson Quadrant
Erickson-Pear No Change
Erickson-Pear Proposed
Erickson-Pear Proposed
Reconfigure the Erickson Ave & Pear St intersection to restrict left turns and through movements off of Pear St onto Erickson Ave. Install traffic signal on Erickson Ave to the east for U-Turns.
2.94
Please rate this scenario:
Optional Comment
Safety
Congestion
Direct Access
Pedestrian Accommodations
Bicycle Accommodations
Worse than today
Better than today
LEGEND
PROPOSED NEW PAVEMENT
PROPOSED MEDIAN
PROPOSED SIDEWALK REROUTING
LEFT TURN ROUTE EXAMPLE
PEAR STREET
Proposed Traffic Signal
EricksonPear Prop...
1 2 3 4 5
53 (25%) 34 (16%) 36 (17%) 59 (27%) 34 (16%)
Times rated: 216
Average rating: 2.940



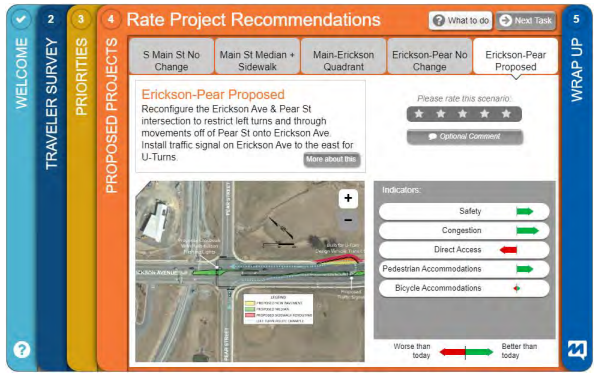
2.08

#1: No Change



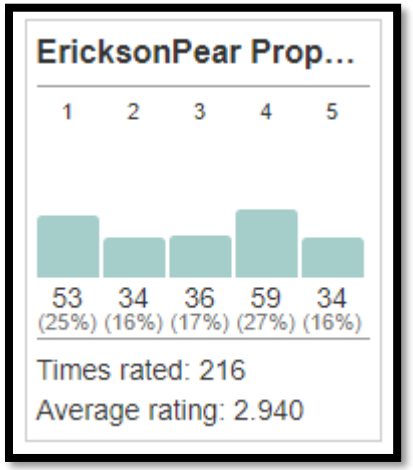
2.94

#2: Proposed RCUT



2.94

#2: Proposed RCUT



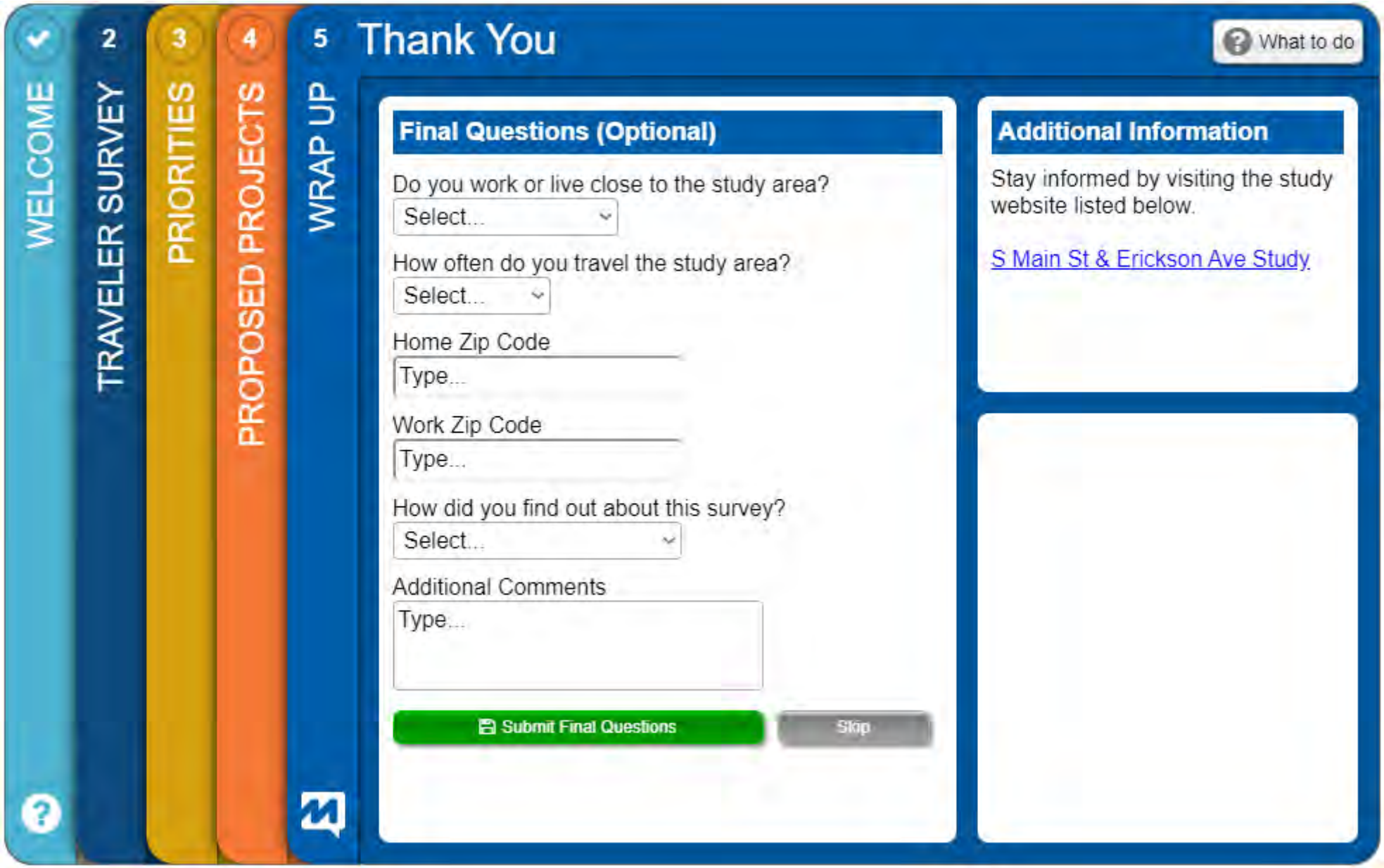
Survey comments in favor:

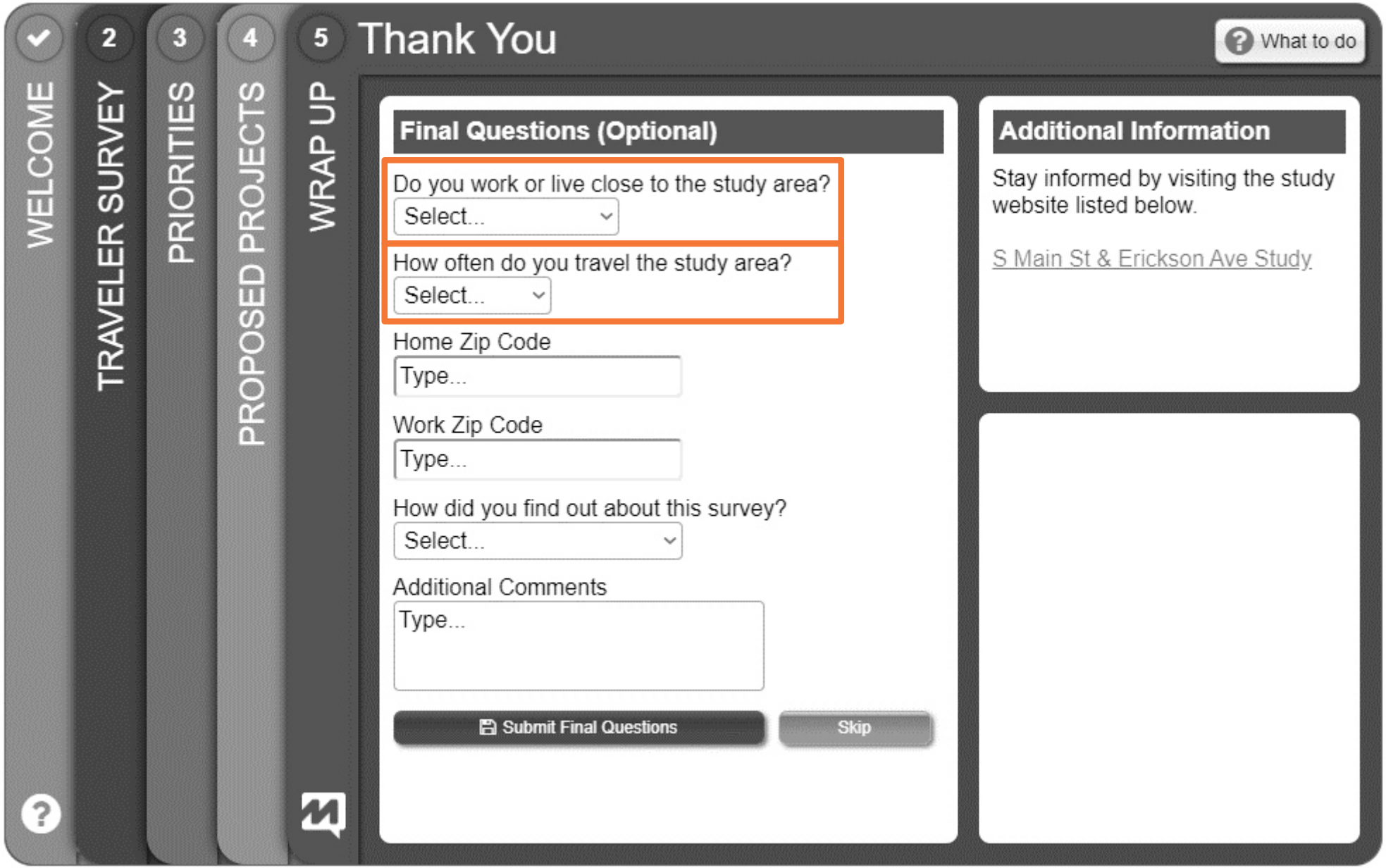
- *"Great solution. Please ensure a bicycle can pass straight through."*
- *"I feel like we are living in the backwoods when it comes to safety and congestion. Every other state I visit except Virginia already uses these things and they work great."*

Survey comments in opposition:

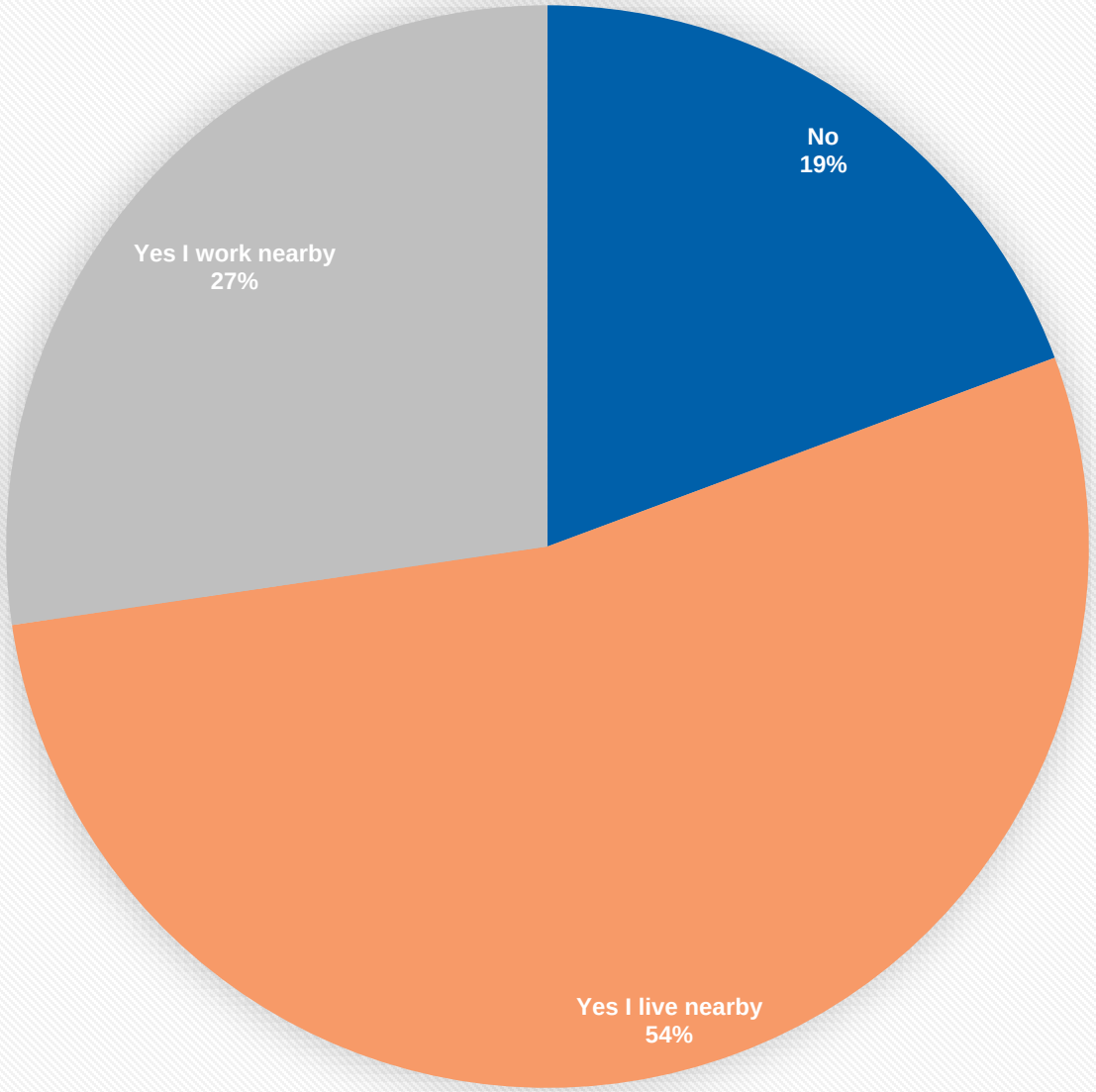
- *"I think a stoplight here timed with the one on 42 is an easier fix."*
- *"Doesn't seem to help with the traffic wanting to cross Erickson from the north…"*
- *Disrupting the flow of Pear across Erickson is disruptive to people like me who live on Pear, and will put more pressure on Pear/High, which is also a dangerous and difficult left turn to get back to Erickson."*

Survey Analysis: Respondent Info

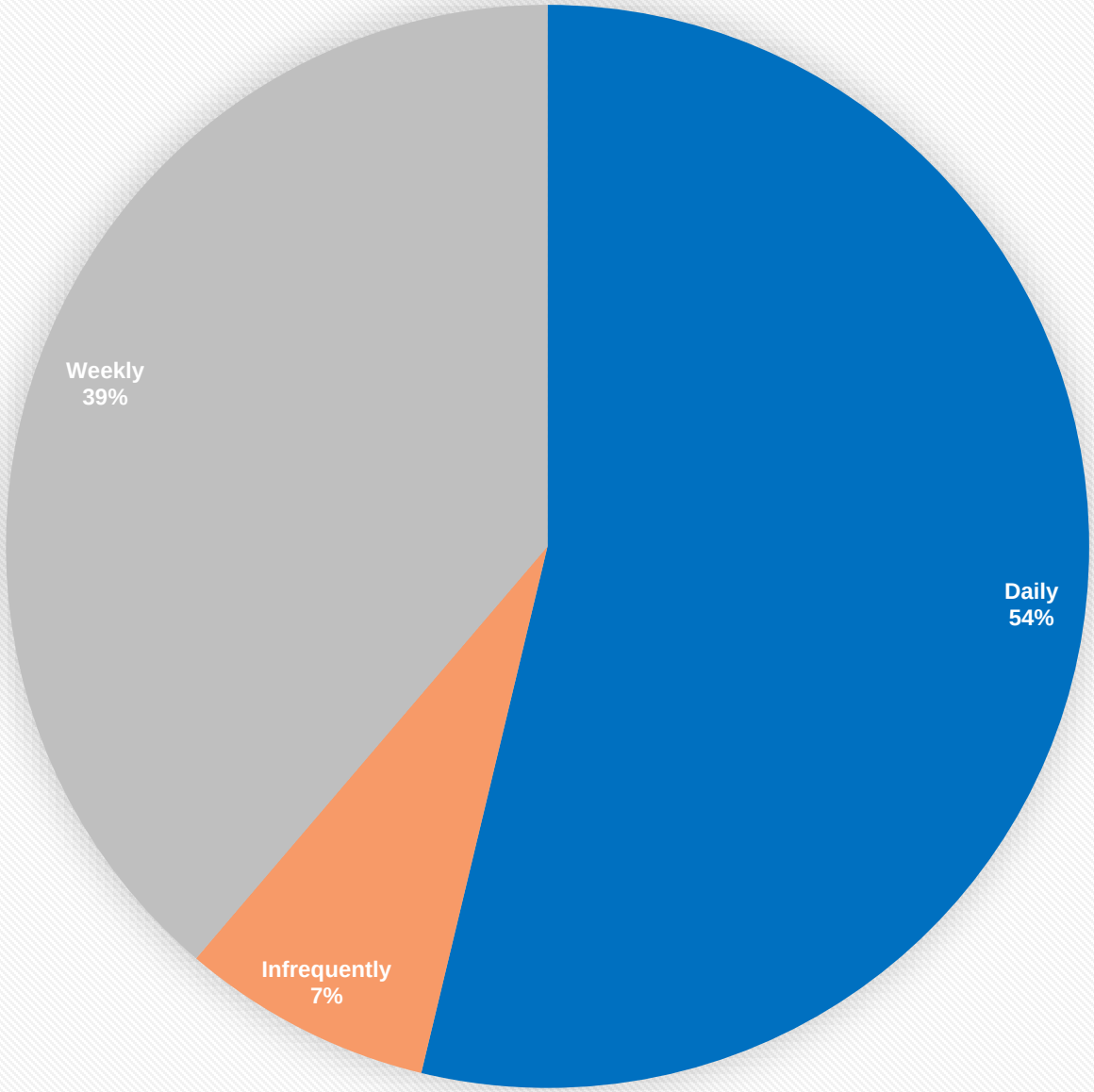

WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
5
WRAP UP
Thank You
What to do
Final Questions (Optional)
Do you work or live close to the study area?
Select...
How often do you travel the study area?
Select...
Home Zip Code
Type...
Work Zip Code
Type...
How did you find out about this survey?
Select...
Additional Comments
Type...
Submit Final Questions
Skip
Additional Information
Stay informed by visiting the study website listed below.
S Main St & Erickson Ave Study

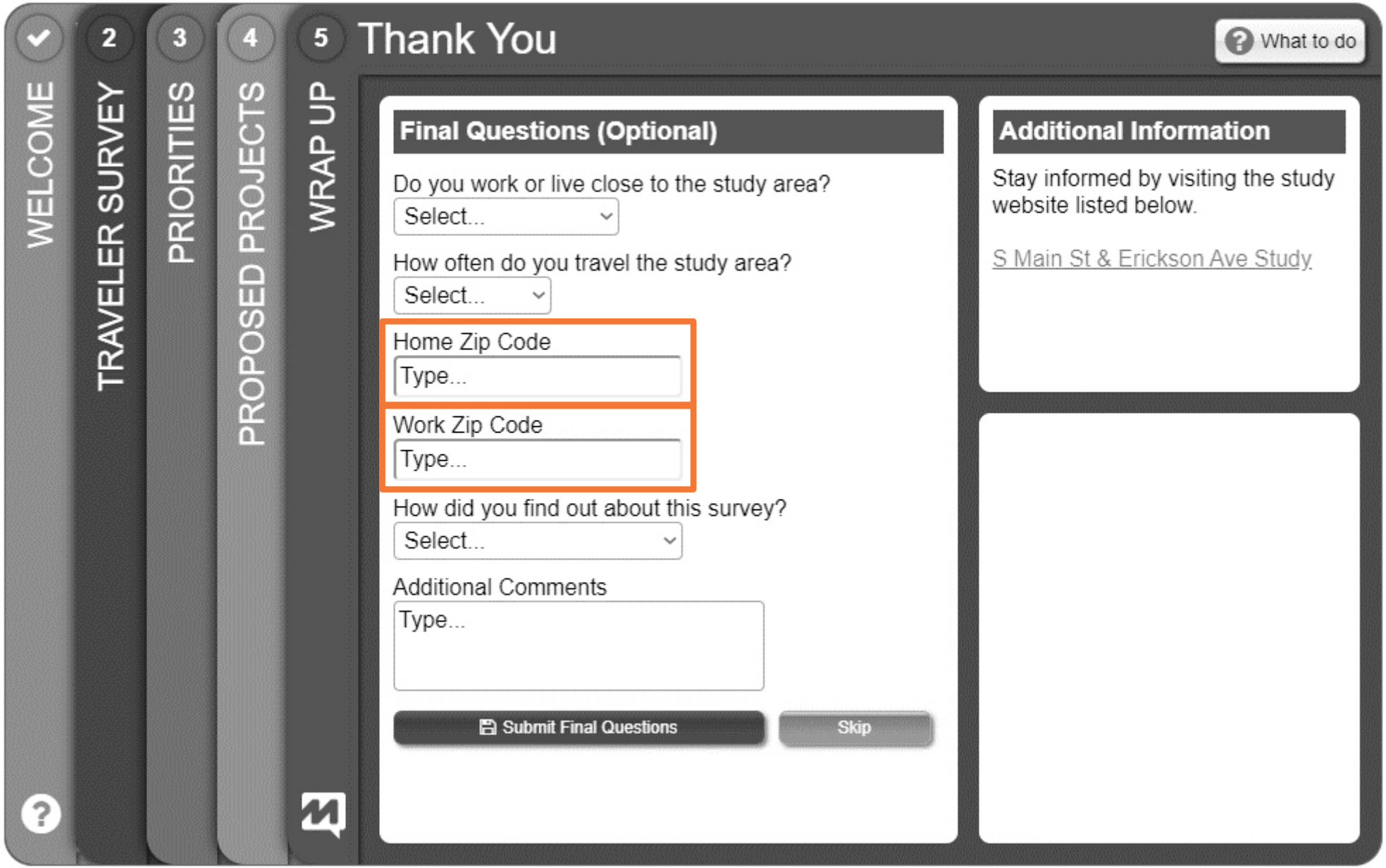

WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
5
WRAP UP
Thank You
What to do
Final Questions (Optional)
Do you work or live close to the study area?
Select...
How often do you travel the study area?
Select...
Home Zip Code
Type...
Work Zip Code
Type...
How did you find out about this survey?
Select...
Additional Comments
Type...
Submit Final Questions
Skip
Additional Information
Stay informed by visiting the study website listed below.
S Main St & Erickson Ave Study

Do you work or live close to the study area?

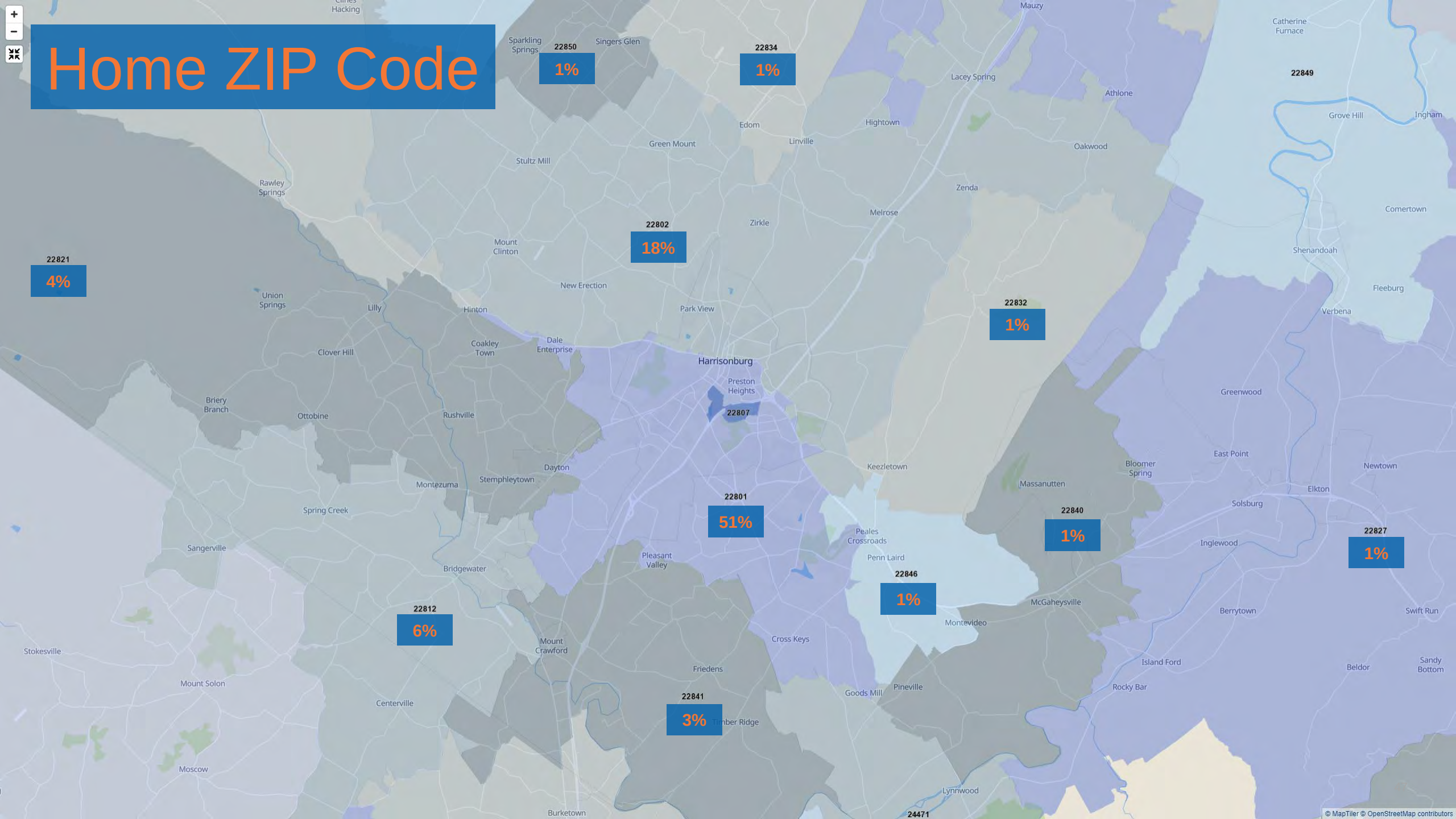


How often do you travel the study area?

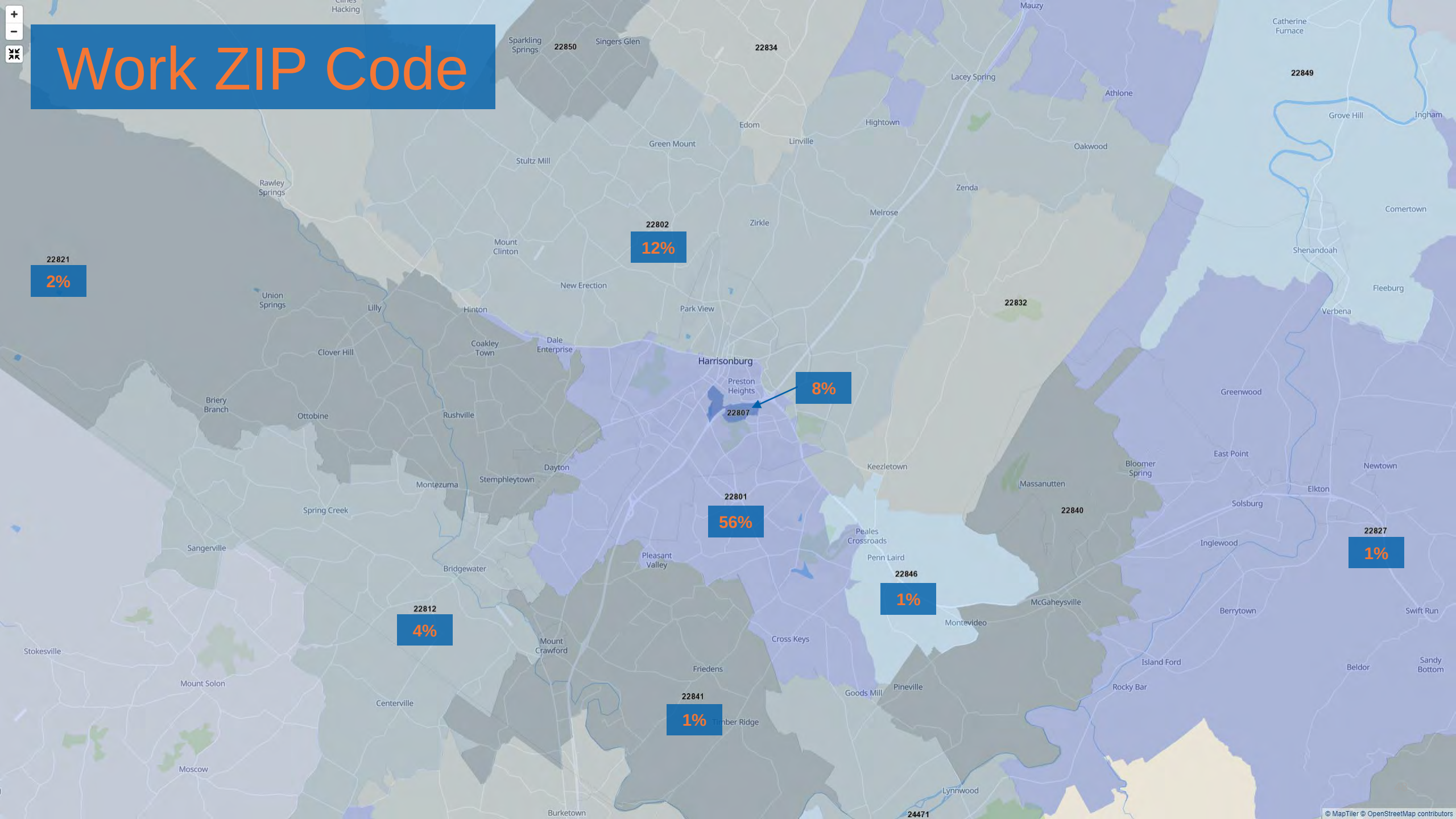



WELCOME
2
TRAVELER SURVEY
3
PRIORITIES
4
PROPOSED PROJECTS
5
WRAP UP
Thank You
What to do
Final Questions (Optional)
Do you work or live close to the study area?
Select...
How often do you travel the study area?
Select...
Home Zip Code
Type...
Work Zip Code
Type...
How did you find out about this survey?
Select...
Additional Comments
Type...
Submit Final Questions
Skip
Additional Information
Stay informed by visiting the study website listed below.
S Main St & Erickson Ave Study

Home ZIP Code



Work ZIP Code



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Key Takeaways

Of 872 respondents…

73%

are commuters

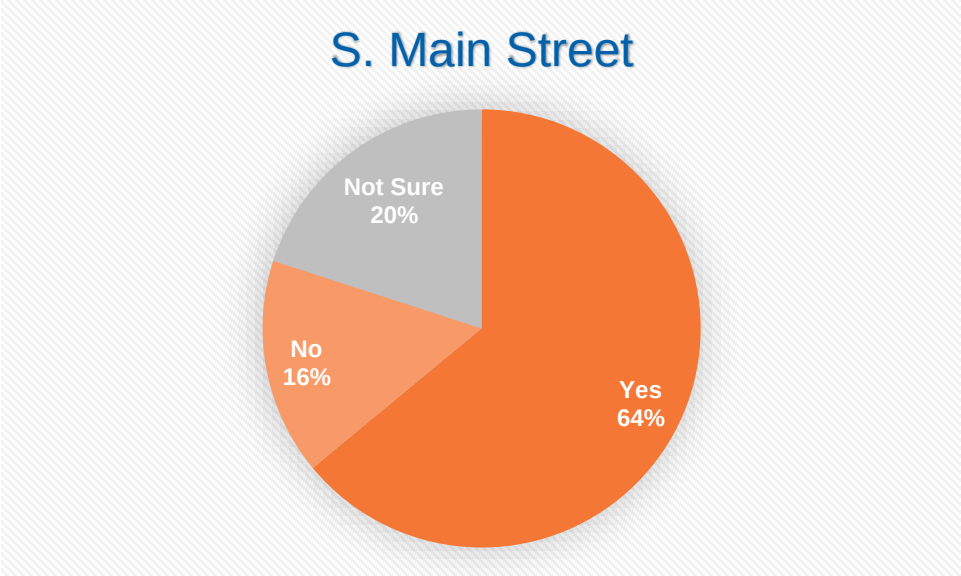
85%

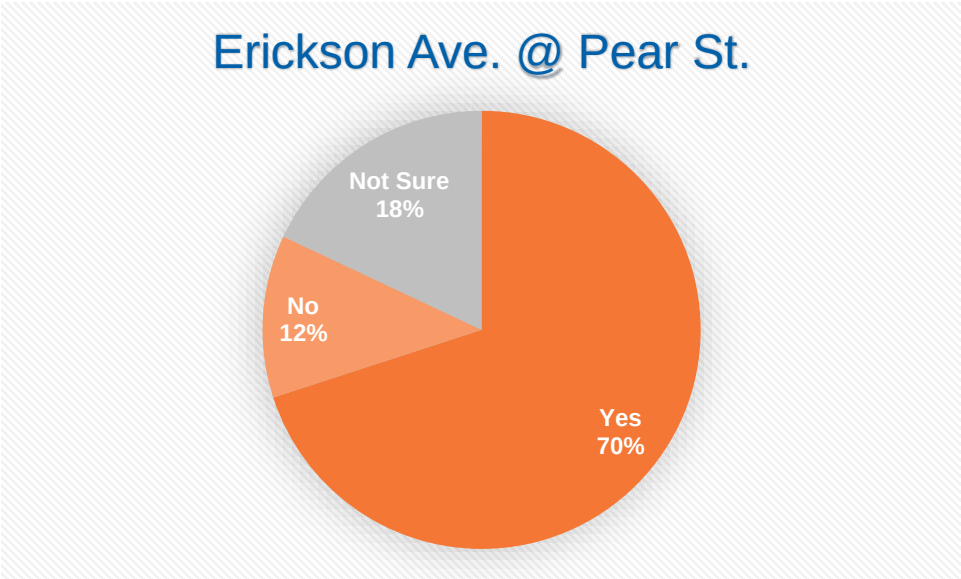
operate passenger vehicles

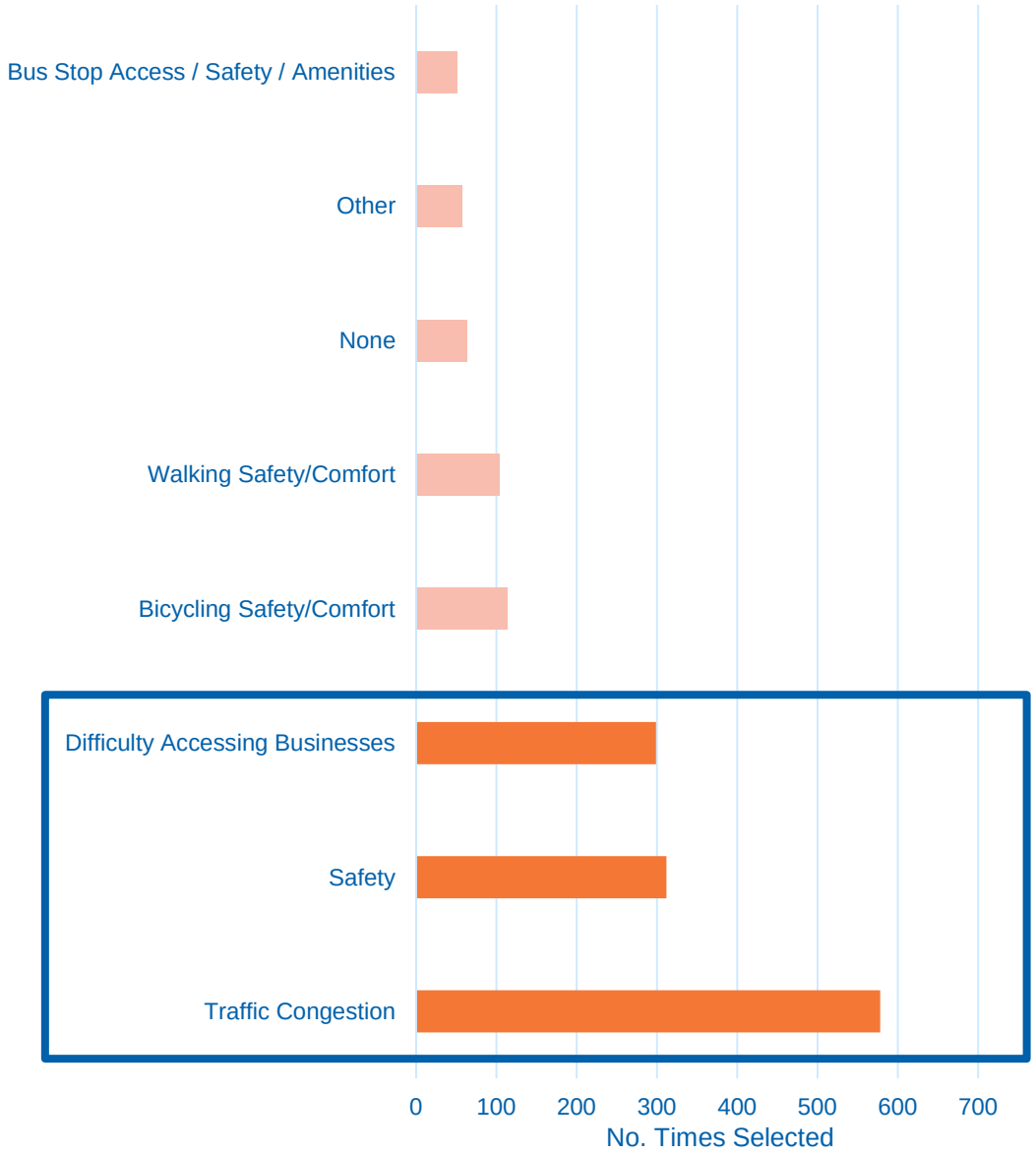
Most respondents identify as **commuters** operating **passenger vehicles**…

Are changes needed at…?

…Who agree that **changes are needed** at both sites.

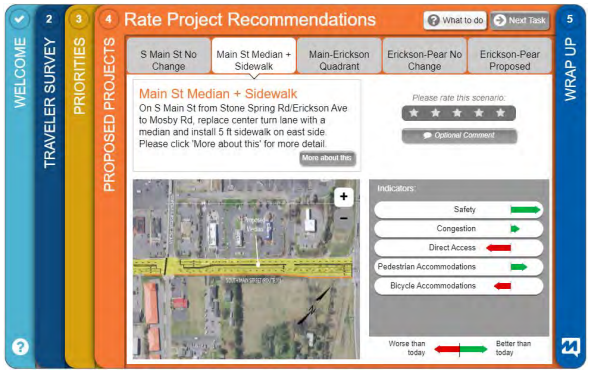






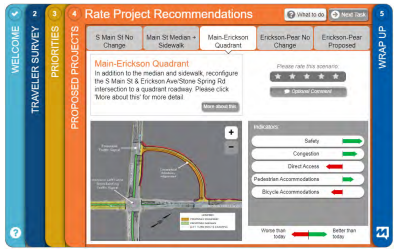
The top three concerns for the S. Main St. corridor are **traffic congestion**, **safety**, and **difficulty accessing businesses**.

Safety, **access**, and **congestion mitigation** were identified as equal priorities.



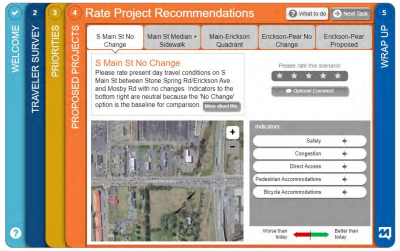
2.97

#2: Median & Sidewalk



2.58

#3: Quadrant



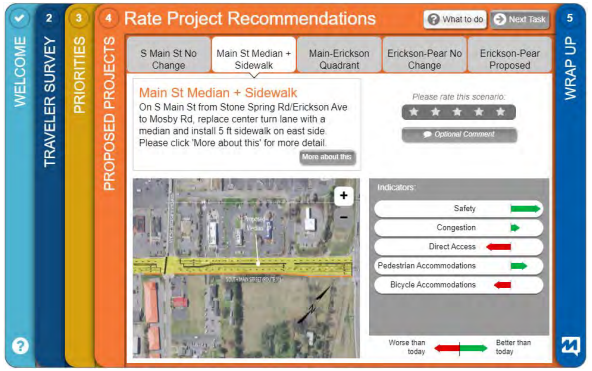
2.49

#1: No Change

Along S. Main Street, the **median/sidewalk solution** was slightly favored.

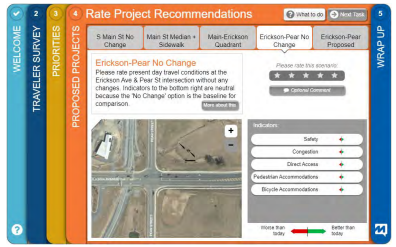
Bicycle access is a going concern.

The **proposed RCUT solution** at Pear St. & Erickson Ave. is strongly preferred to taking no action.



2.94

#2: Proposed RCUT



2.08

#1: No Change

Thank You!
Additional Information:

http://www.virginiadot.org/projects/staunton/harrisonburg_-_south_main_street_corridor_and_erickson_avenue_-_pear_street_intersection.asp