W. Mitchell Street, W. Forest Home Avenue & S. 13th Street Intersection Redesign

URB 772 Spring 2022

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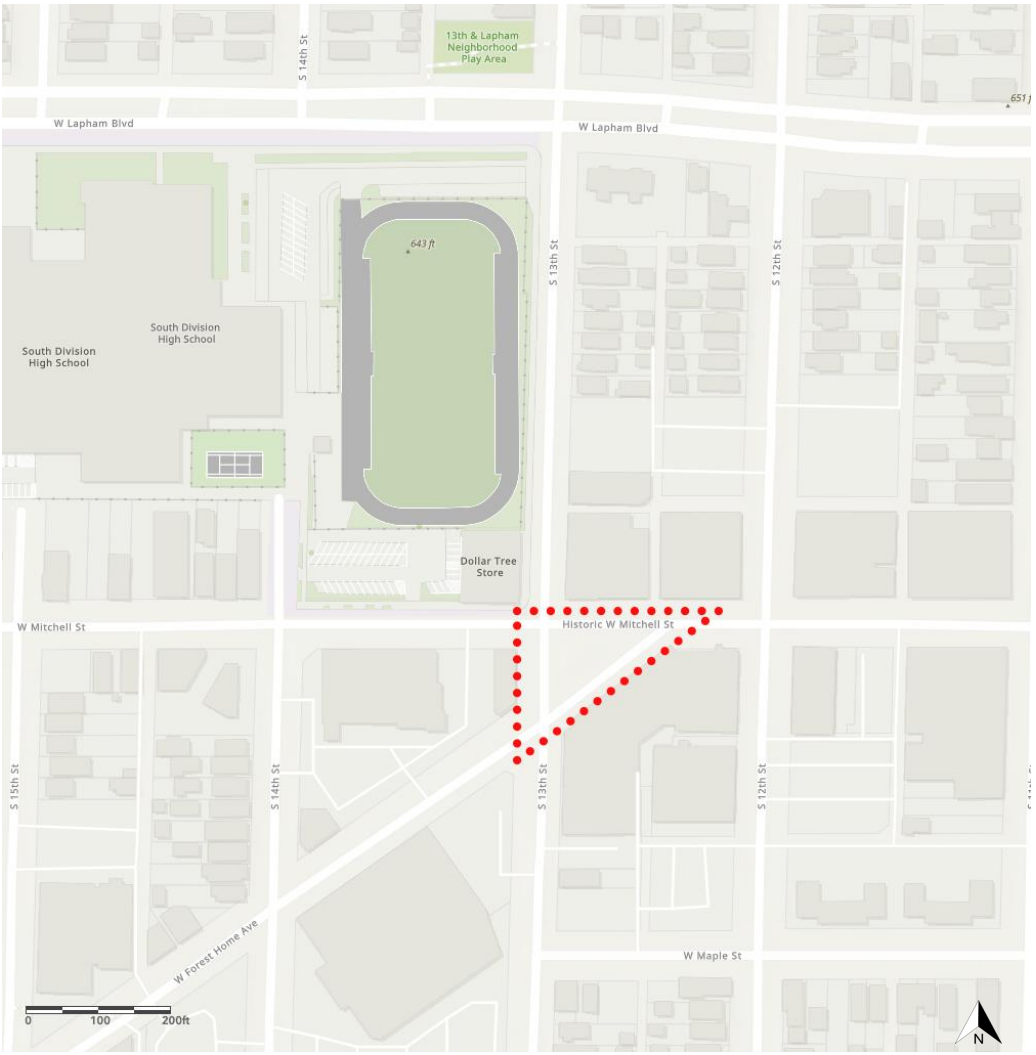
Neighborhood Context

Historic Mitchell Street Neighborhood

Milwaukee County Census Tract 168

Mix of surrounding land uses:

- Small scale commercial
- Residential
- Civic and education



Map created with ArcGIS

Neighborhood Characteristics

Population density: 15,125 per square mile

Median Household Income: $33,897

35.5% of residents are below poverty line

78.2% of residents are Hispanic or Latino

Ranked 8th most walkable Milwaukee neighborhood with Walk Score of 85

Historic shopping and commercial district

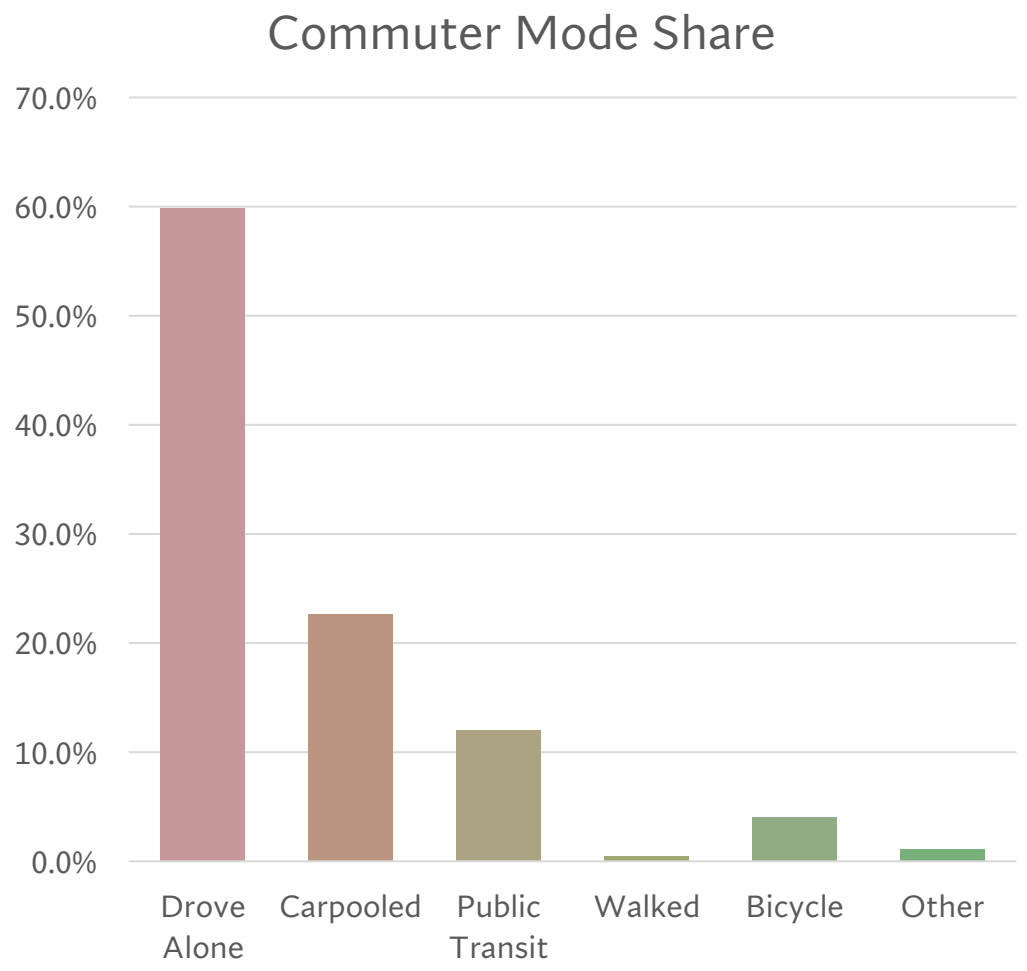


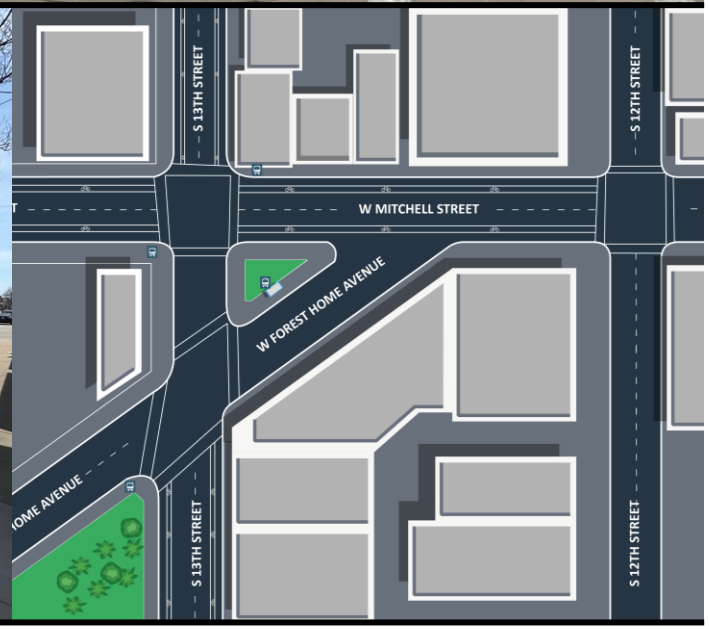
Chart and data from U.S. Census Bureau 2020 Decennial Census and 2020 ACS 5-Year Estimates

Existing Conditions

Intersection of three major arterials

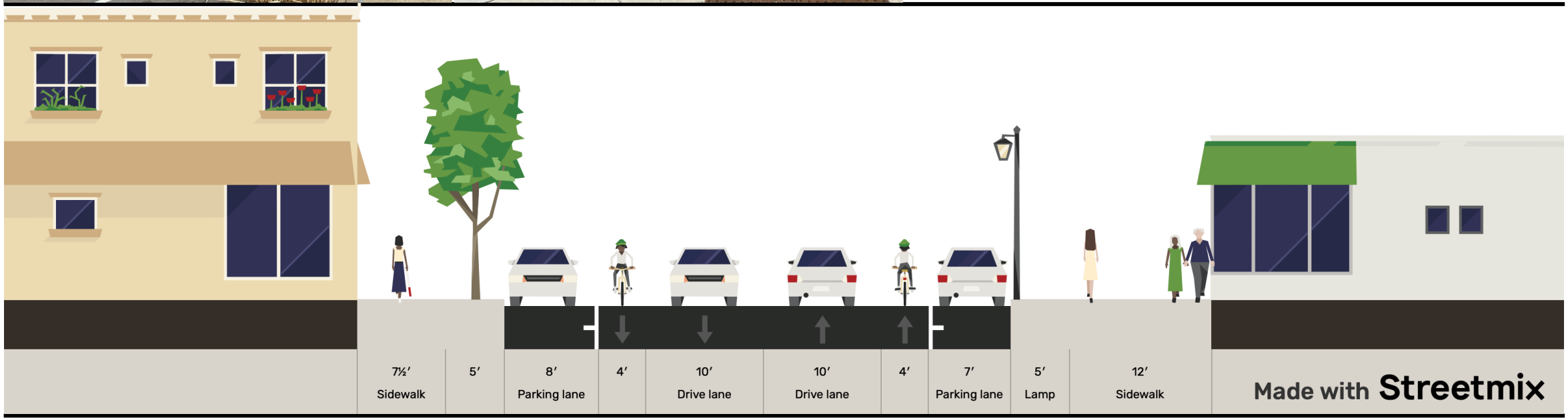
Served by MCTS Routes 20 and 54

Portions of intersection are signalized



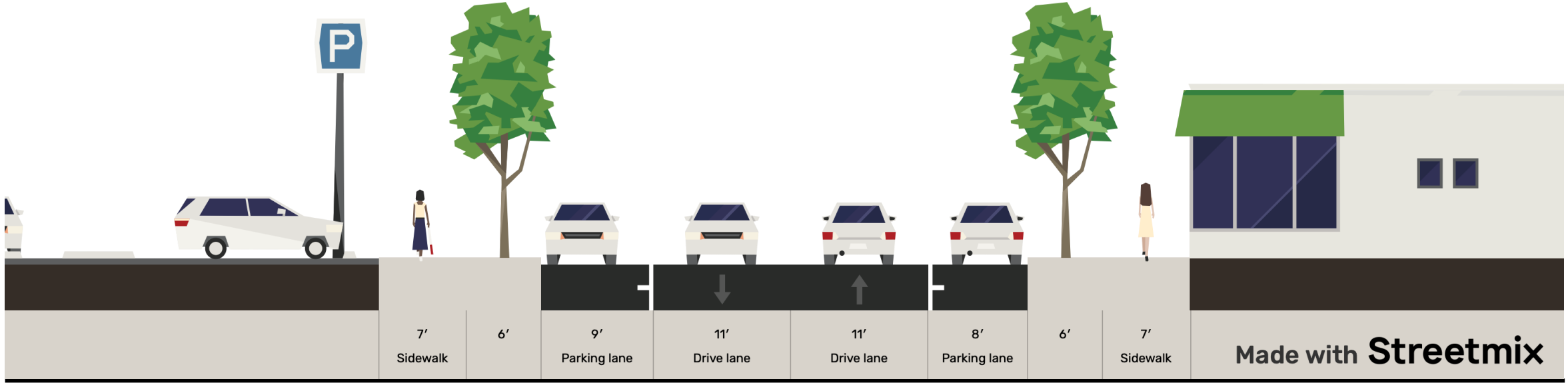
Existing Conditions Mitchell St.

43’ Roadway Width



Existing Conditions Forest Home Ave.

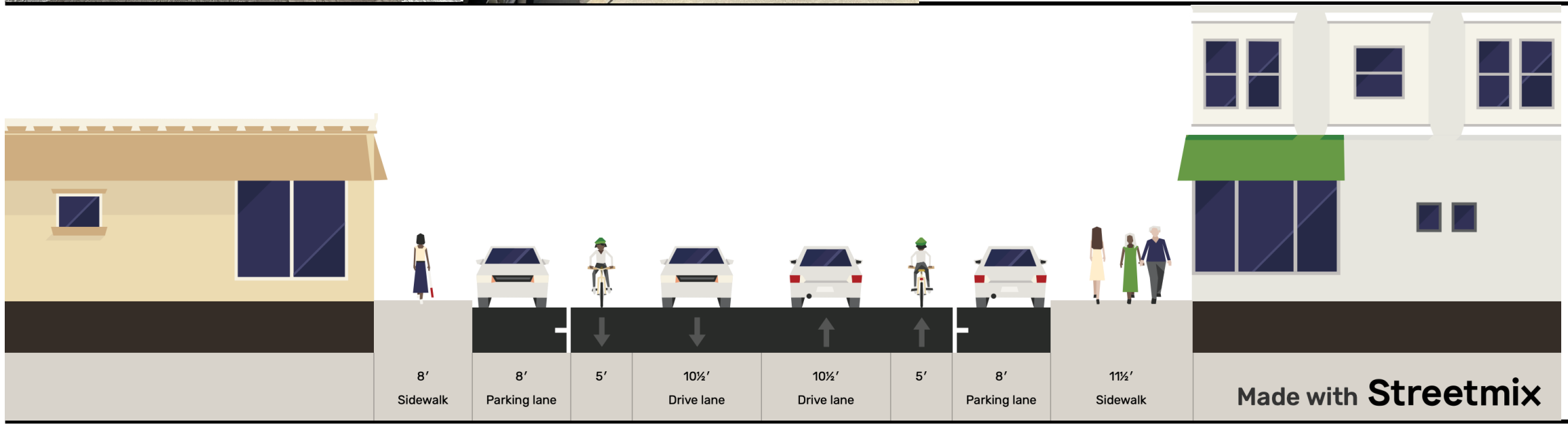
39’ Roadway Width



Existing Conditions

S 13th St.

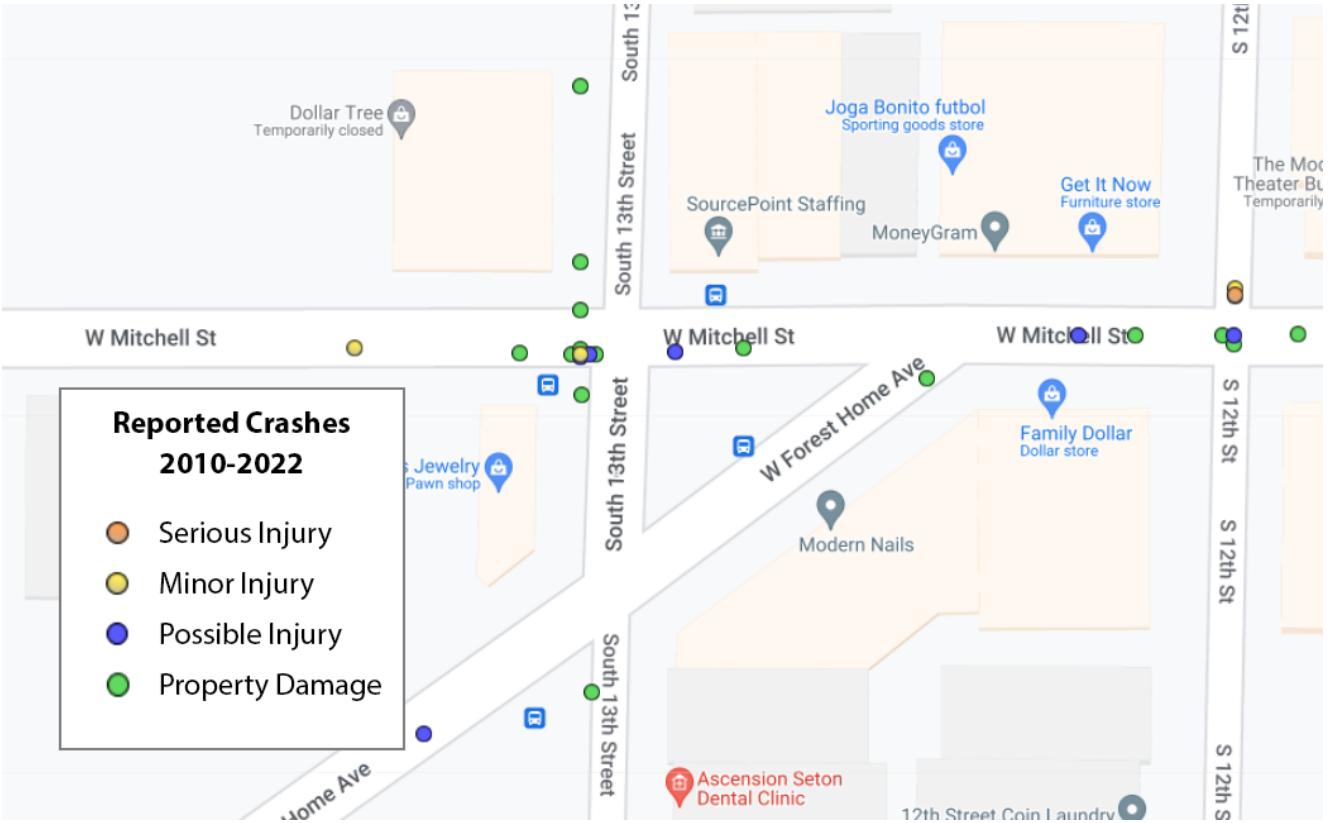
47’ Roadway Width



Existing Conditions

Annual Traffic Counts		
Street Name	Daily	Hourly
Mitchell	4,400	183
Forest Home	3,600	150
13th Street	4,400	183

Source: WisDOT. https://wisdot.maps.arcgis.com/apps/webappviewer/index.html?id=2e12a4f051de4ea9bc865ec6393731f8



Source: Community Maps - Wisconsin County TSC Crash Mapping.
https://transportal.cee.wisc.edu/partners/community-maps/crash/search/BasicSearch.do

Intersection	Mitchell, Forest Home, 13th
Date	Friday 4/22/2022
Time	9:20 - 11:20 AM
Temp (F)	41
Weather	Overcast, light rain

Leg	13th/Mitchell	13th/Forest Home	Mitchell/Forest Home	12th/Mitchell
North	16 ped, 1 bike (cross)	6 ped, 1 bike	n/a	18 ped
East	1 ped	9 ped, 1 bike	22 ped	4 ped
South	8 ped	39 ped, 1 bike	11 ped, 1 bike (right turn)	30 ped, 2 bike (straight)
West	19 ped, 1 bike (left turn)	36 ped, 1 bike	10 ped	18 ped
Misc	2 ped diagonal NW to SE			

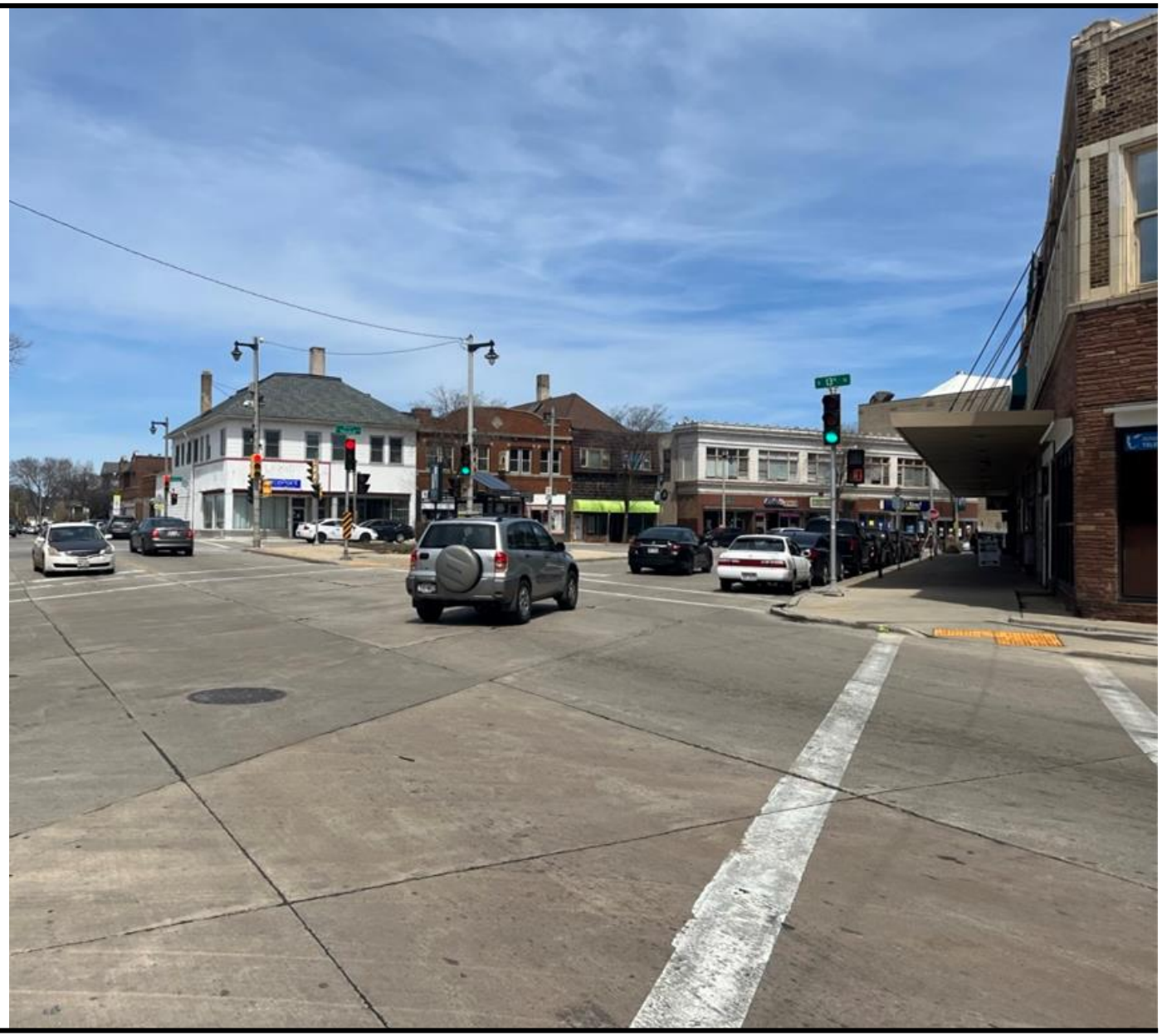
Problems

High vehicle speeds through intersection

Low visibility of pedestrian crossing

Long crosswalks for pedestrians

Obstructed and unprotected bike lanes



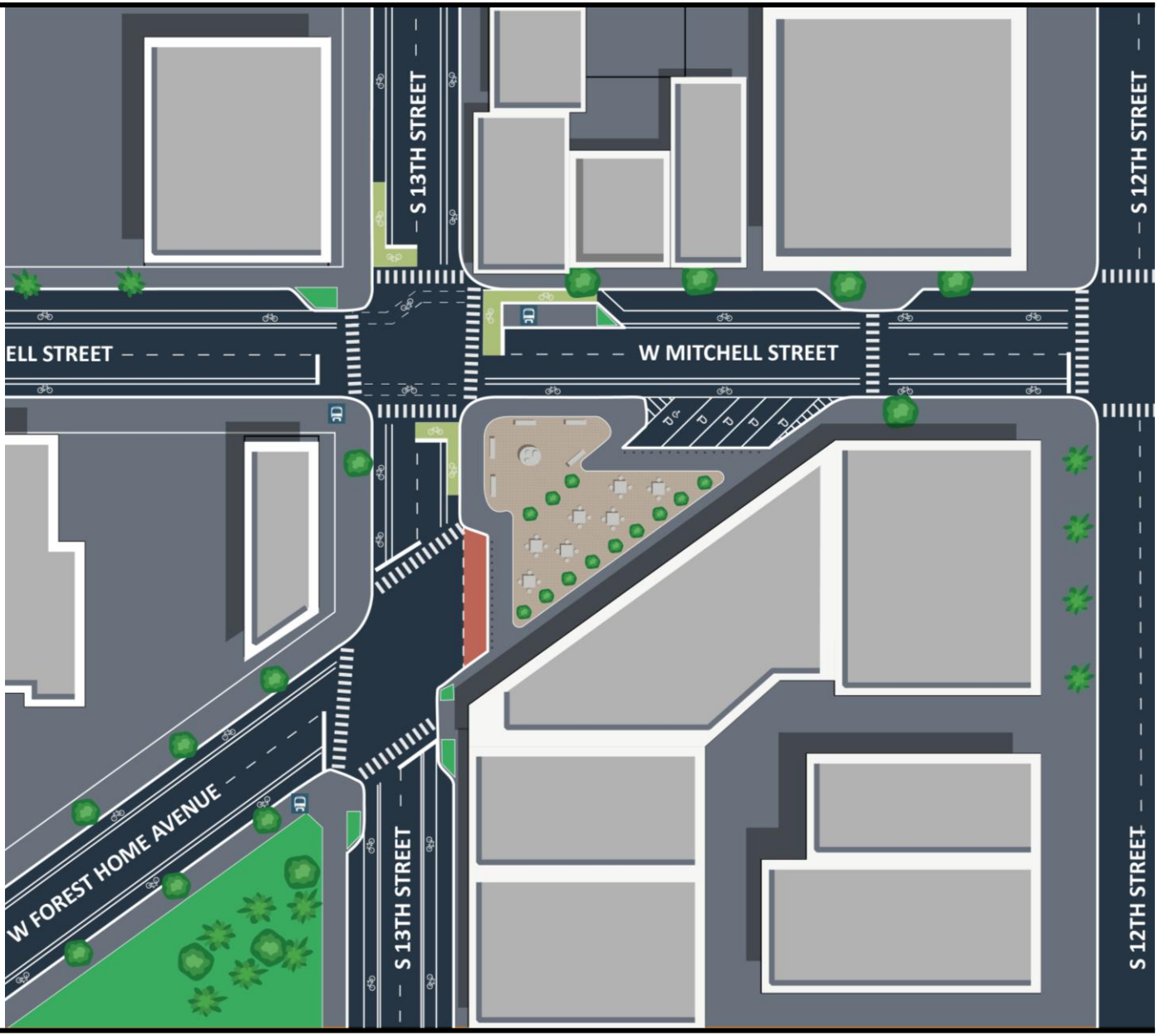
Intersection Redesign

Introduction of public plaza

Safer intersection for cyclists

Eliminating unsafe vehicular crossing

Safer midblock crossing

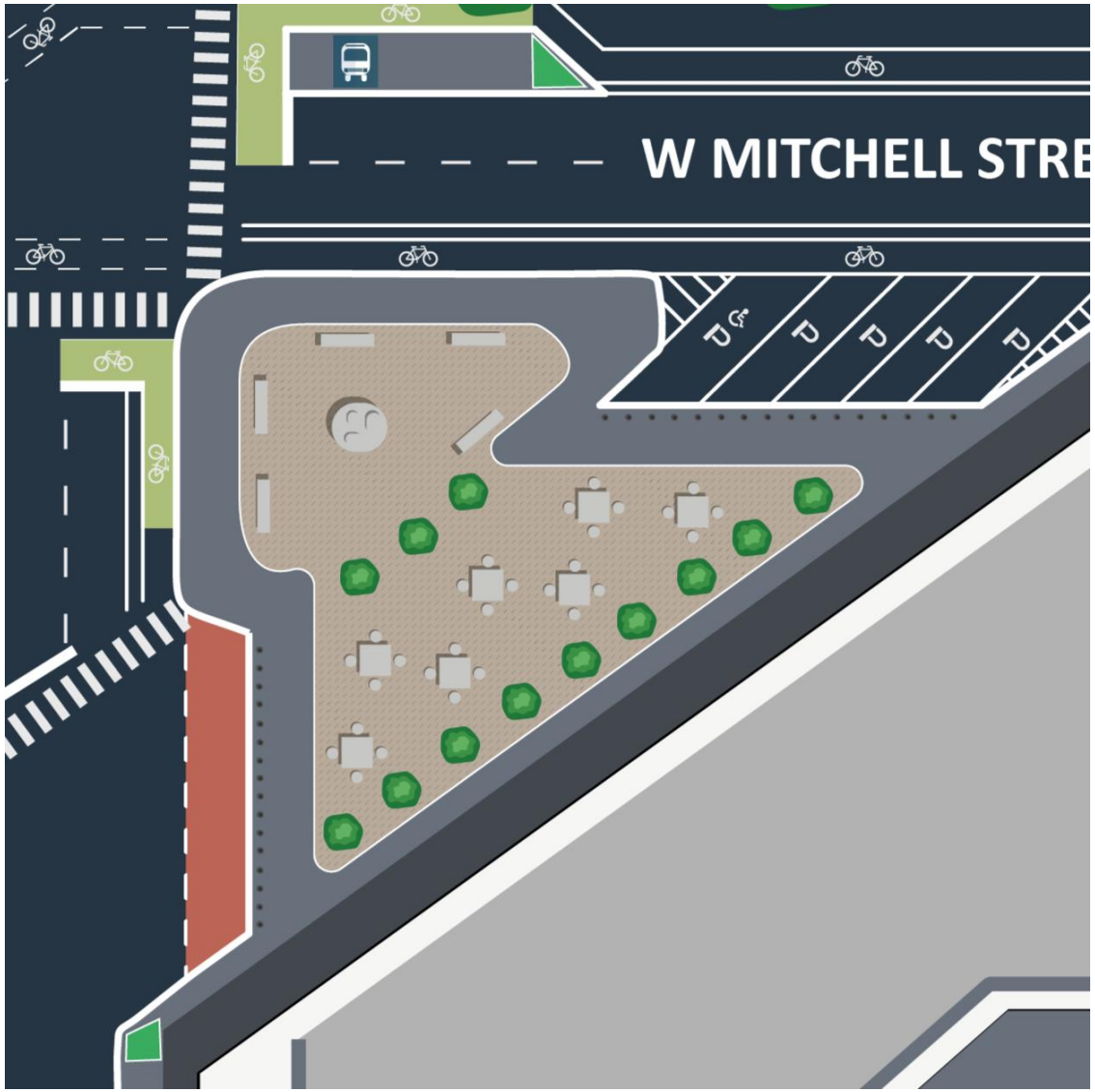


Introduction of Public Plaza

Creates a more pedestrian friendly space

Marks gateway to Historic Mitchell Street

Adds a destination spot for adjacent businesses

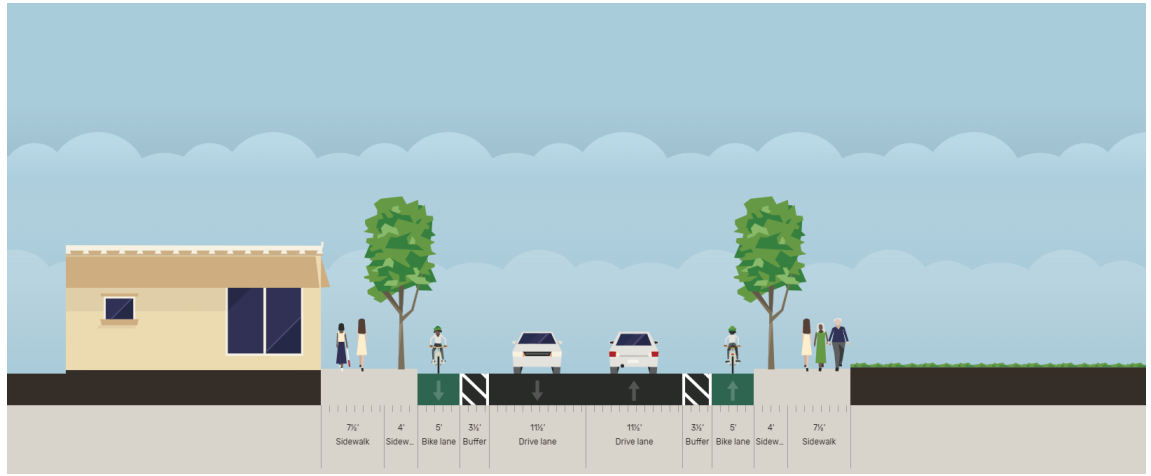


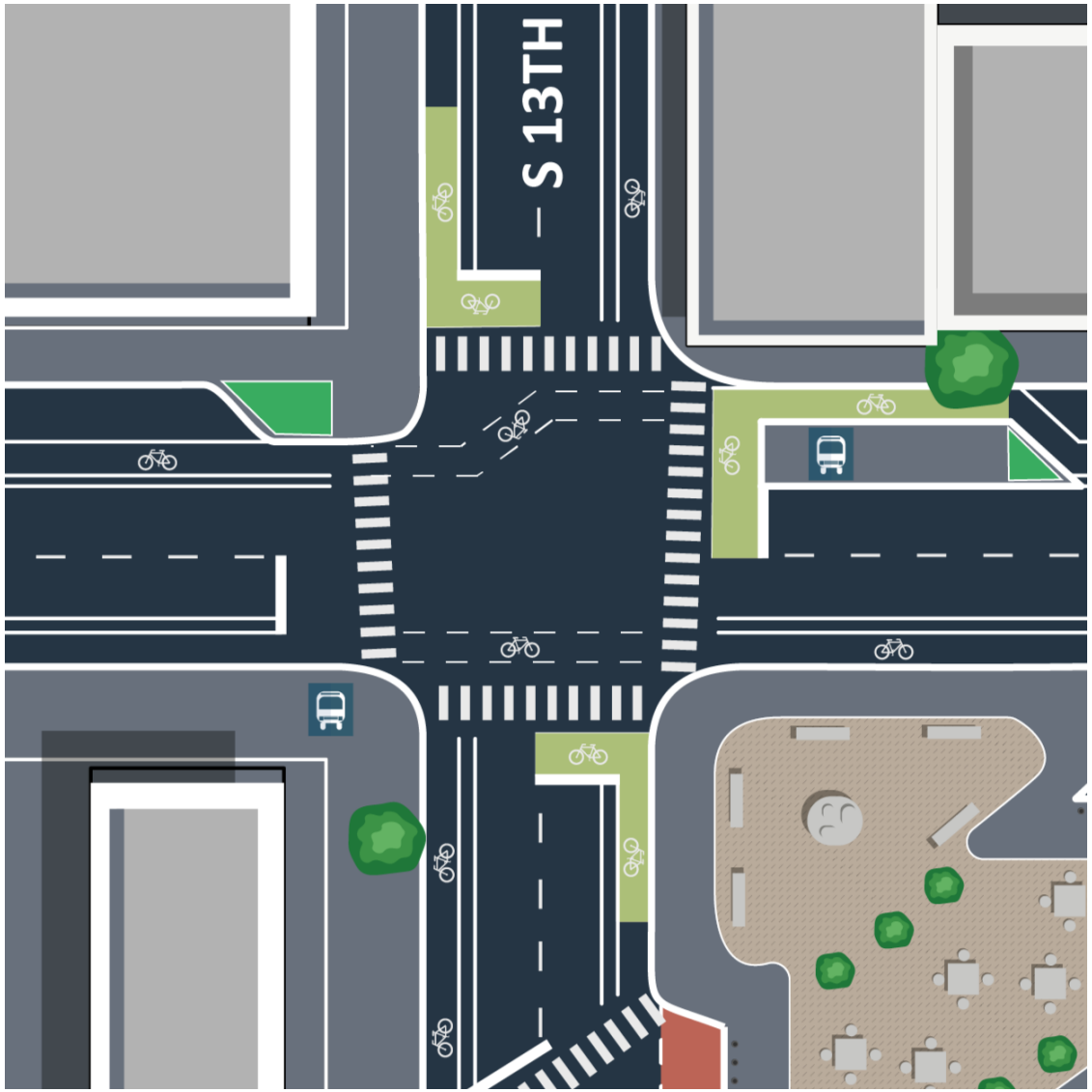
Safer Intersection for Cyclists

Safer cyclist travel lanes along major arterials

Safer transition spaces for cyclists

Better balance for all street users



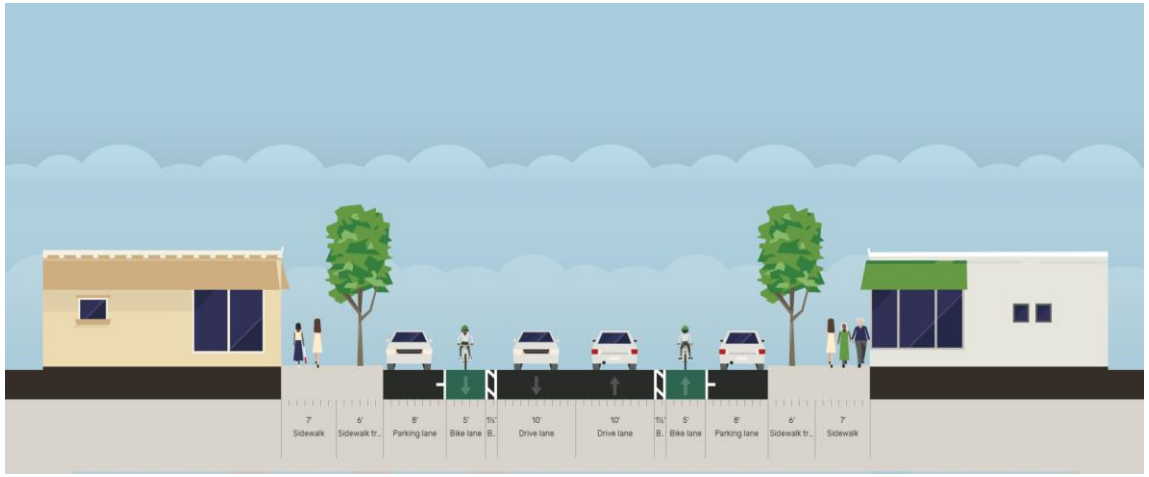


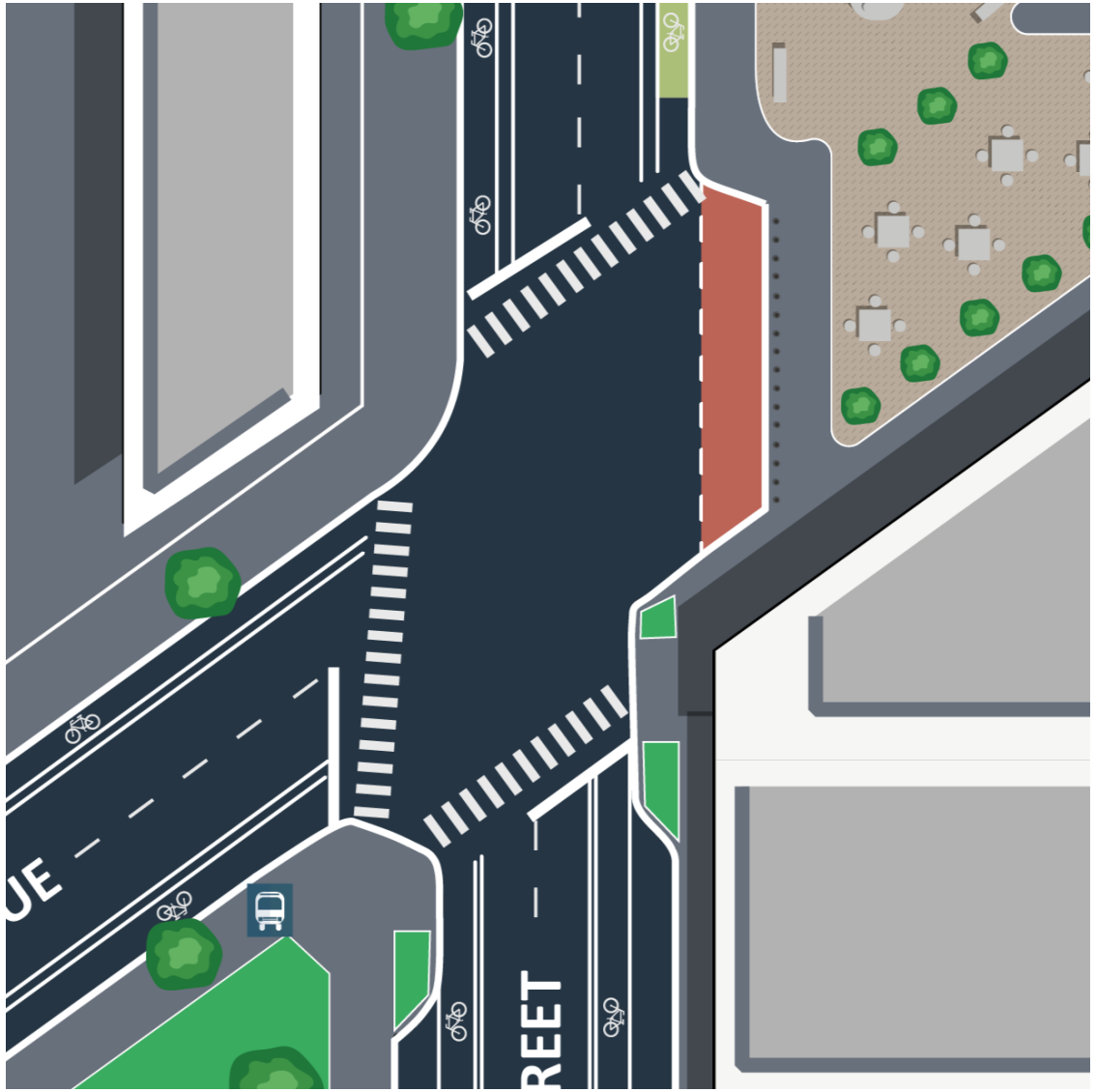
Eliminating Unsafe Vehicular Crossing

Limits through traffic to W. Mitchell St

Safer transition from W. Forest Home

Less stress for cyclist traffic on S. 13th St



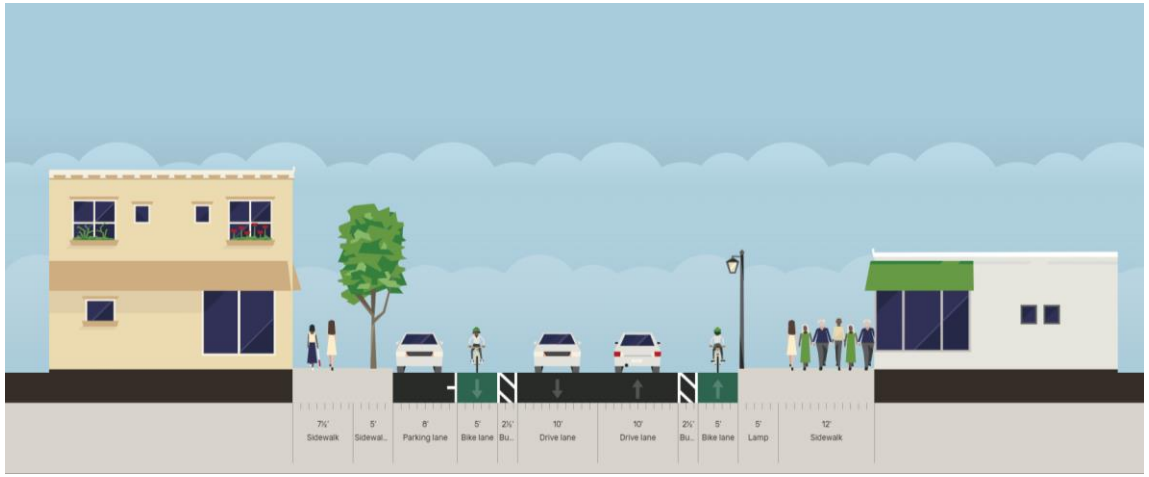


Safer Midblock Crossing

High pedestrian travel to businesses

Shorter distance for pedestrian crossing

Angle parking for better vision



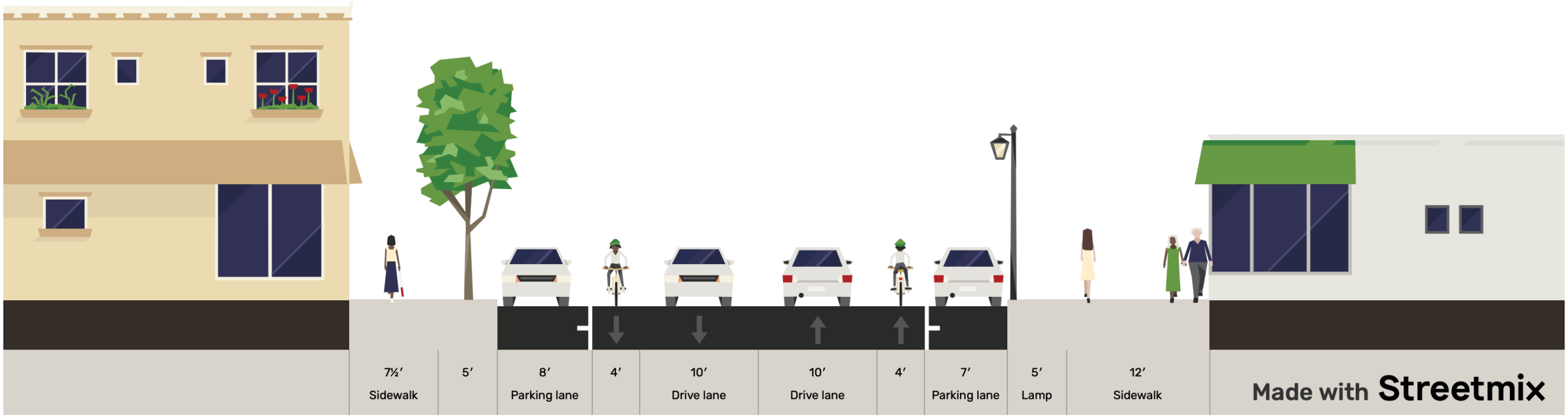
Bicycle & Pedestrian Level of Service
Mitchell St. – Existing

Level of Service – Westbound

- Pedestrian LOS: **A (1.31)**
- Bicycle LOS: **E (4.31)**

Level of Service – Eastbound

- Pedestrian LOS: **A (1.57)**
- Bicycle LOS: **D (3.50)**



Note: please see the Appendix for calculation breakdowns.

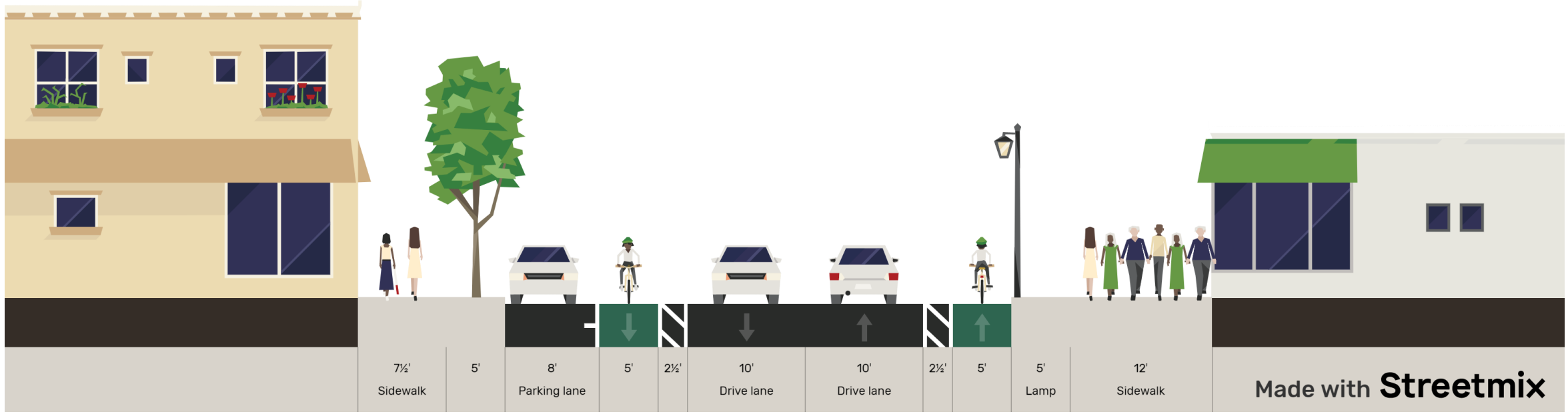
Bicycle & Pedestrian Level of Service
Mitchell St. – Redesign

Level of Service – Westbound

- Pedestrian LOS: **A (0.90)**
- Bicycle LOS: **C (3.15)**

Level of Service – Eastbound

- Pedestrian LOS: **A (1.48)**
- Bicycle LOS: **A (1.51)**

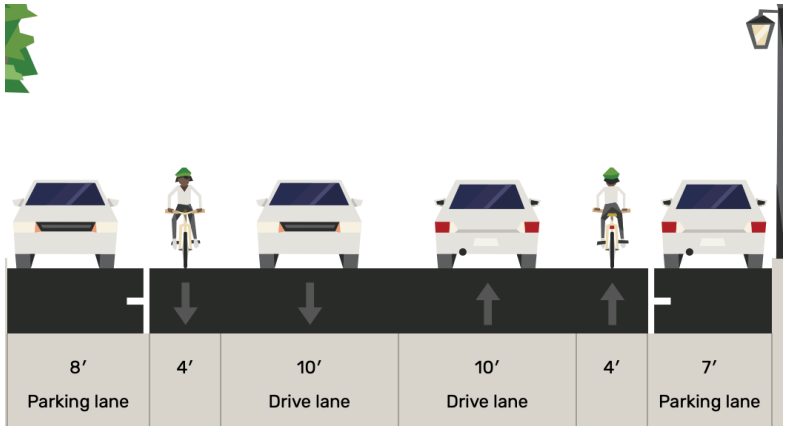


Note: please see the Appendix for calculation breakdowns.

Bicycle Level of Traffic Stress
Mitchell St.

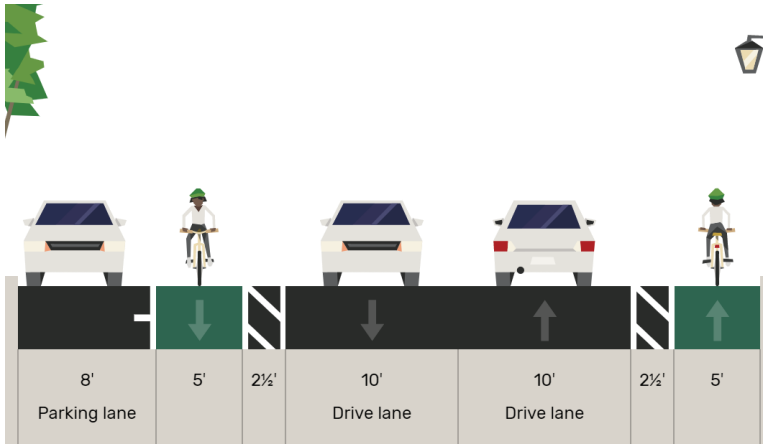
Existing Conditions: **LTS 3**

- Bike Lane Width: 4ft
- Prevailing Speed: 31mph
- Unlaned 2-way street
- Effective ADT: 4,400



Proposed Redesign: **LTS 1**

- Buffered Bike Lane: 7.5 ft
- Parking & Buffered Bike Lane: 15.5ft
- Prevailing Speed: 25mph
- Effective ADT: 4,400



Note: please see the Appendix for the details. The prevailing speed for the existing condition is the 85th percentile from the Milwaukee Non-arterial Street Speed Studies provided by Dr. Robert Schneider. The prevailing speed for the proposed redesign is the current speed limit on the street.

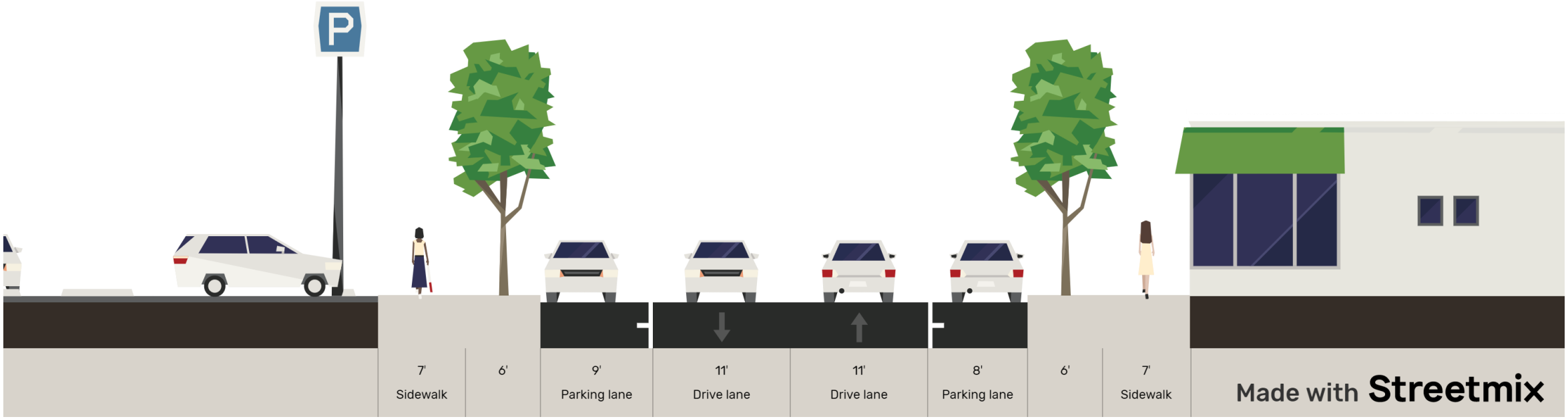
Bicycle & Pedestrian Level of Service
Forest Home Ave. – Existing

Level of Service – Northeast bound

- Pedestrian LOS: **A (1.30)**
- Bicycle LOS: **E (4.40)**

Level of Service – Southwest bound

- Pedestrian LOS: **A (1.30)**
- Bicycle LOS: **E (4.44)**



Note: please see the Appendix for calculation breakdowns.

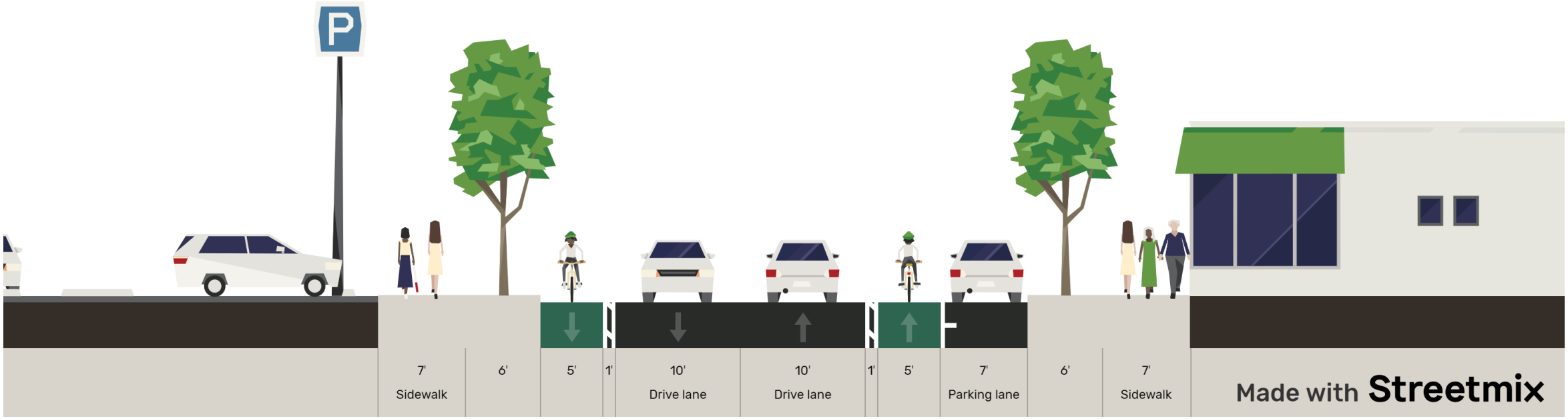
Bicycle & Pedestrian Level of Service
Forest Home Ave. – Redesign

Level of Service – Northeast bound

- Pedestrian LOS: **A (0.93)**
- Bicycle LOS: **E (4.30)**

Level of Service – Southwest bound

- Pedestrian LOS: **A (0.93)**
- Bicycle LOS: **D (3.64)**

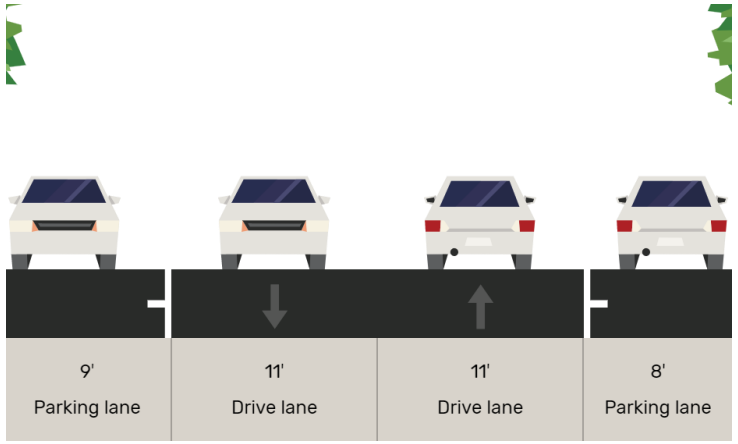


Note: please see the Appendix for calculation breakdowns.

Bicycle Level of Traffic Stress
Forest Home Ave.

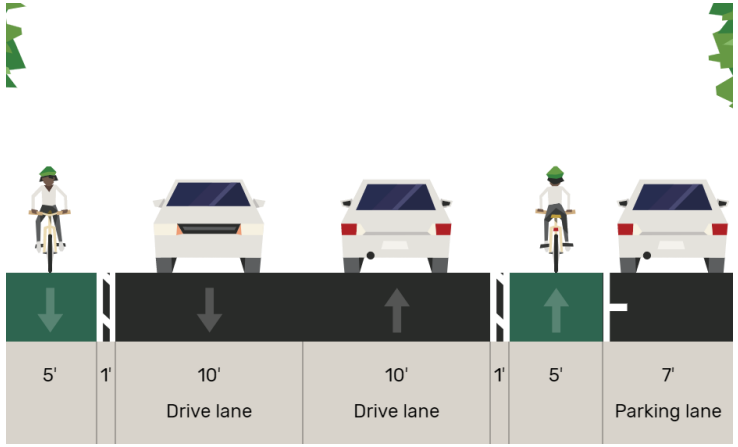
Existing Conditions: **LTS 3**

- Bike Lane Width: 0ft
- Prevailing Speed: 30mph
- Unlaned 2-way street
- Effective ADT: 3,600



Proposed Redesign: **LTS 2**

- Buffered Bike Lane Width: 6ft
- Parking & Buffered Bike Lane: 13ft
- Prevailing Speed: 30mph
- Effective ADT: 3,600



Note: please see the Appendix for the details. The prevailing speed for the existing condition and the proposed redesign is the current speed limit on the street.

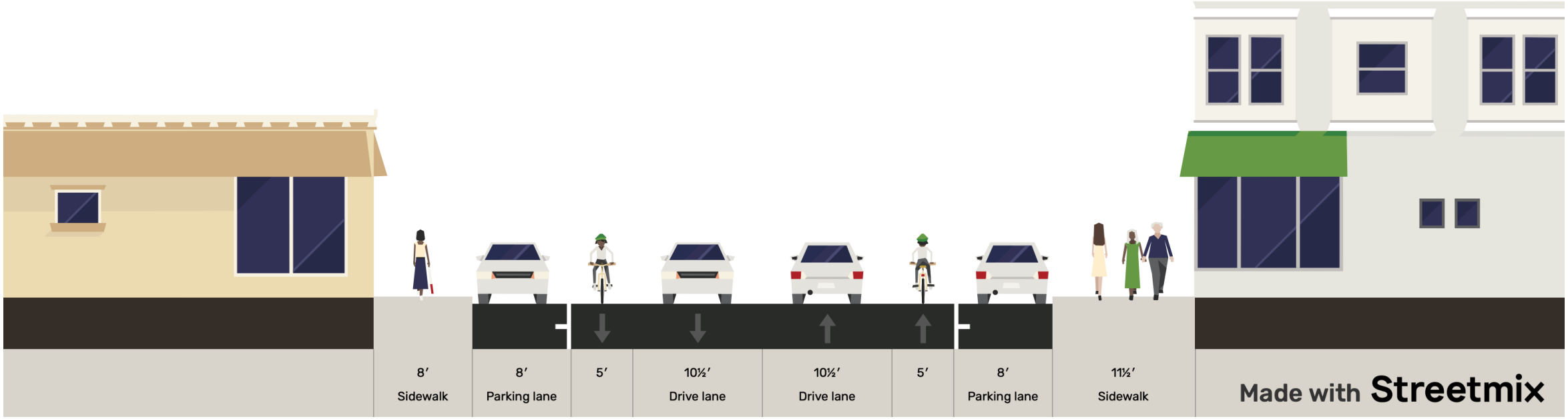
Bicycle & Pedestrian Level of Service
S 13th St. – Existing

Level of Service – Northbound

- Pedestrian LOS: **A (1.78)**
- Bicycle LOS: **E (4.76)**

Level of Service – Southbound

- Pedestrian LOS: **A (1.76)**
- Bicycle LOS: **E (4.76)**



Note: please see the Appendix for calculation breakdowns.

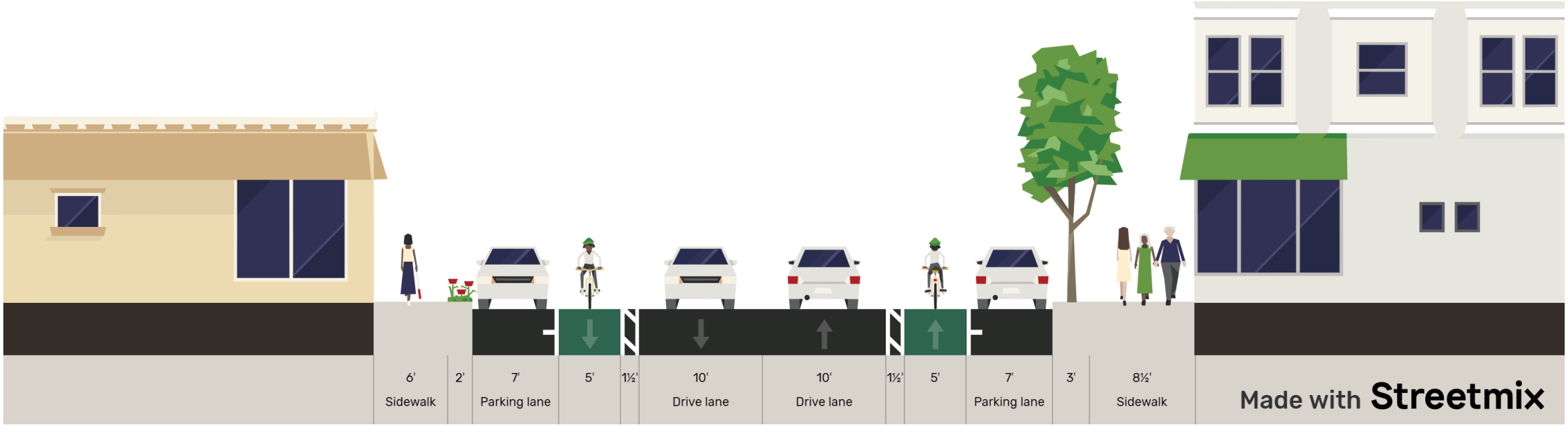
Bicycle & Pedestrian Level of Service
S 13th St. – Redesign

Level of Service – Northbound

- Pedestrian LOS: **A (1.49)**
- Bicycle LOS: **D (4.03)**

Level of Service – Southbound

- Pedestrian LOS: **A (1.36)**
- Bicycle LOS: **D (4.03)**



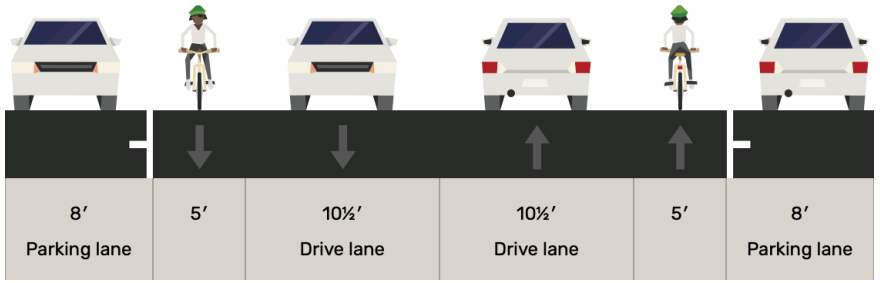
Note: please see the Appendix for calculation breakdowns.

Bicycle Level of Traffic Stress

S 13th St.

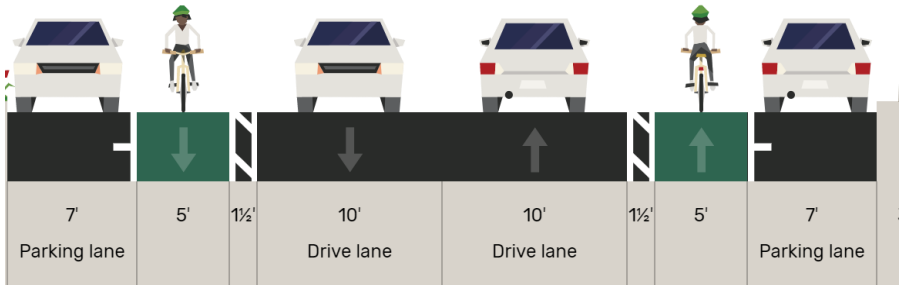
Existing Conditions: **LTS 4**

- Bike Lane Width: 5ft
- Prevailing Speed: 36mph
- Unlaned 2-way street
- Effective ADT: 4,400



Proposed Redesign: **LTS 2**

- Buffered Bike Lane Width: 6.5 ft
- Parking & Buffered Bike Lane: 13.5ft
- Prevailing Speed: 30mph
- Effective ADT: 4,400



Note: please see the Appendix for the details. The prevailing speed for the existing condition is the 85th percentile from the Milwaukee Non-arterial Street Speed Studies provided by Dr. Robert Schneider. The prevailing speed for the proposed redesign is the current speed limit on the street.

Intersection Redesign Costs

Phase 1	Location	Est. Cost	Unit	Quantity	Low Estimate	High Estimate
Stripe high visibility crosswalks	Multiple	$500 to $1,500	each	12	$6,000.00	$18,000.00
Install rectangular rapid flashing beacons	Forest Home and Mitchell	$10,000 to $20,000	each	1	$10,000.00	$20,000.00
Install Loading Zone sign	Plaza Area at 13th	$75	each	1	$75.00	$75.00
Restripe Loading and Parking Zone	Edges of Plaza Area	$4.33	ft	310	$1,342.30	$1,342.30
Install Bench	Plaza Area	$1,400 to $4,500	each	6	$8,400.00	$27,000.00
Construct separated cycle track	Mitchell St, 13th, and Forest Home	$19 to $568	ft	984	$18,696.00	$558,912.00
Install bicycle box	Mitchell and 13th	$2,500 to $5,000	each	4	$10,000.00	$20,000.00

Phase 2	Location	Est. Cost	Unit	Quantity	Low Estimate	High Estimate
Upgrade existing signal to audible pedestrian signal	Mitchell and 13th	$5,000	each	4	$20,000.00	$20,000.00
Plant Street Trees	Plaza Area	$350	each	12	$4,200.00	$4,200.00
Install Bus Stop Shelter	Mitchell and 13th, East leg	$7,500	each	1	$7,500.00	$7,500.00
Pave 6" Raised Plaza	Plaza Area	$8.39	sq ft	3,240	$27,183.60	$27,183.60
Construct new Curb and Gutter	Around Plaza Area	$15	ft	108	$1,620.00	$1,620.00
Construct new Sidewalk	Around Plaza Area	$55	ft	108	$5,940.00	$5,940.00
Construct new ADA Curb Ramp	Plaza Area at Mitchell	$1,000 to $2,000	each	1	$1,000.00	$2,000.00
Install curb extension/bulbout (no drainage relocation)	North side of Mitchell at Forest Home	$5,000 to $10,000	each	5	$25,000.00	$50,000.00

Total Projected Cost

Phase	Low	High
Phase 1	**$54,513.30**	**$645,329.30**
Phase 2	**$92,443.60**	**$118,443.60**

Estimates from City of Milwaukee (2010, 2019); walkinginfo.org (2019); City of Berkeley, CA (2009); City of Alexandria, VA (2007); and Wisconsin DoT (2019-2021)

Challenges of Implementation

- Adjustment of speeds to accommodate other road users
- Pushback on portion of W. Forest Home closure
- Build out of public plaza and design process
- Costly long-lasting redesign elements

Street view of the studied area

Implications for Automobile Travel

Traffic counts low enough to result in minimal overall impact

Improved intersection safety

Reduction in vehicle traffic speeds

Some loss of parking spaces

Street view of the studied area

Education & Enforcement Strategies

Gain support from and establish relationship with traffic safety stakeholders

Establish criteria for measuring bicycling & pedestrian safety

Create marketing communications targeting at high-risk drivers at areas with higher traffic crash rates

Send educational messages with a focus on speeding and sharing the roads with other modes of transportation

Traffic safety flyers displayed in the windows of a nearly business

Justification of Redesign

Street view of the studied area

Appropriate Roadway Context

Improves Suitability

Reduces Crash Risk

Cost Effective Planning

Aligns with Previous Recommendations

Appropriate Roadway Context

- Business heavy pedestrian area
- Large usable space along high demand streets
- Island surrounded by medium traffic arterials

Street view of the studied area

Street view of the studied area

Improved Suitability

- Better balance to current roadway network
- Accommodation for missing parking spots
- MCTS Route 20

Street view of the studied area

Reduces Crash Risk

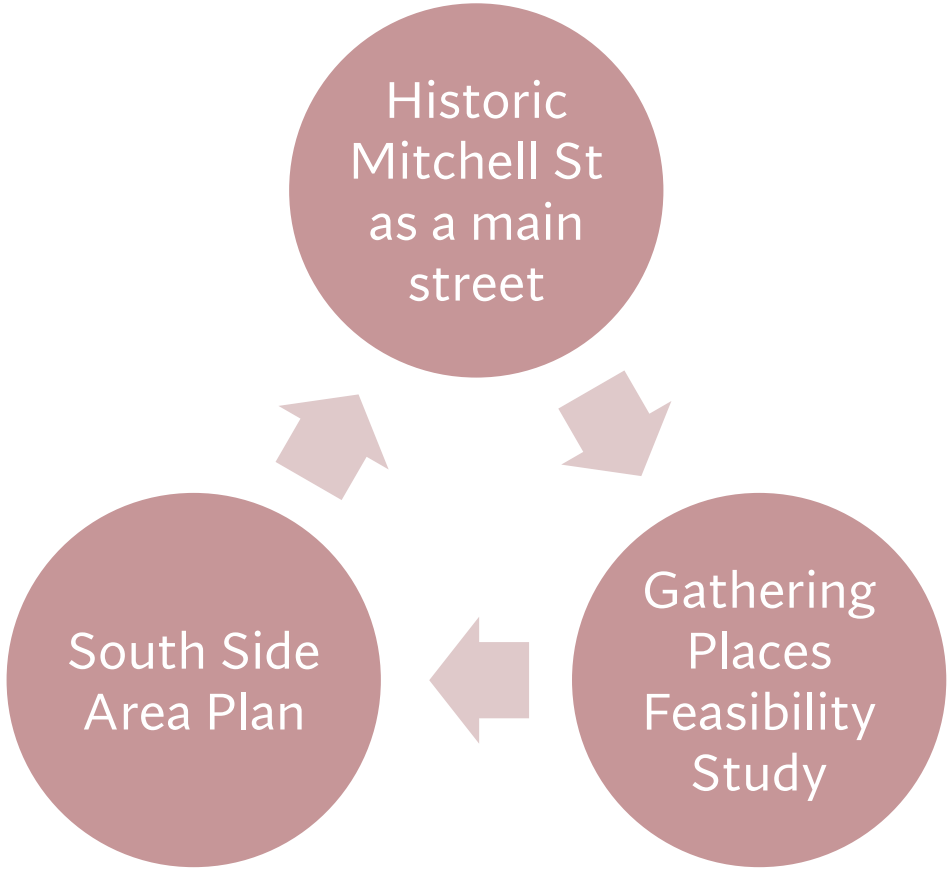
- Slower speeds near intersection
- Changes approach to intersections
- Elimination of vehicular crash risk on W. Forest Home & W. Mitchell St

Cost Effective Planning

- Pragmatic phasing for intersection improvements
- Improves street space for local business
- Safety over price

Street view of the studied area

Aligns with Previous Recommendations



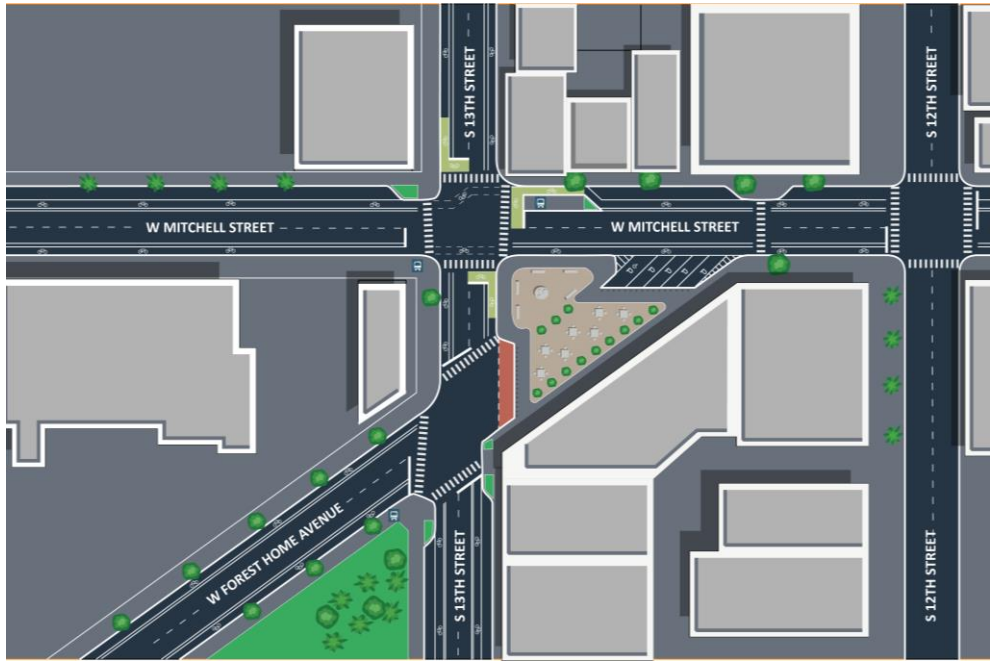
MITCHELL STREET, W. FOREST HOME AVENUE & S. 13TH STREET

A new plaza could be located along Forest Home Ave where it intersects with Historic West Mitchell Street and South 13th Street within the Historic Mitchell Street BID. This large plaza would be about 9,000 square feet, including an existing 3,000 square foot pedestrian island within the intersection.

The South Side Area Plan recommends using the triangle as a gateway marker for the commercial corridor on Mitchell Street. Installing an interim public plaza would follow the pedestrian orientation described in the plan. This plaza would increase open space within the Historic Mitchell Street BID. Changes to traffic signals, coordination with MCTS on bus routing, and analyses of motor vehicle traffic would all be required to determine feasibility.

Image source: City of Milwaukee

Recommended Redesign



Public Plaza
Sourcehttps://nacto.org/publication/urban-street-design-guide/interim-design-strategies/interim-public-plazas/

Harvard University, Campus Martius
Source: https://www.sociallifeproject.org/how-focusing-on-social-life-helps-win-the-climate-war/

Bike Boxes
Source: https://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/bike-boxes/

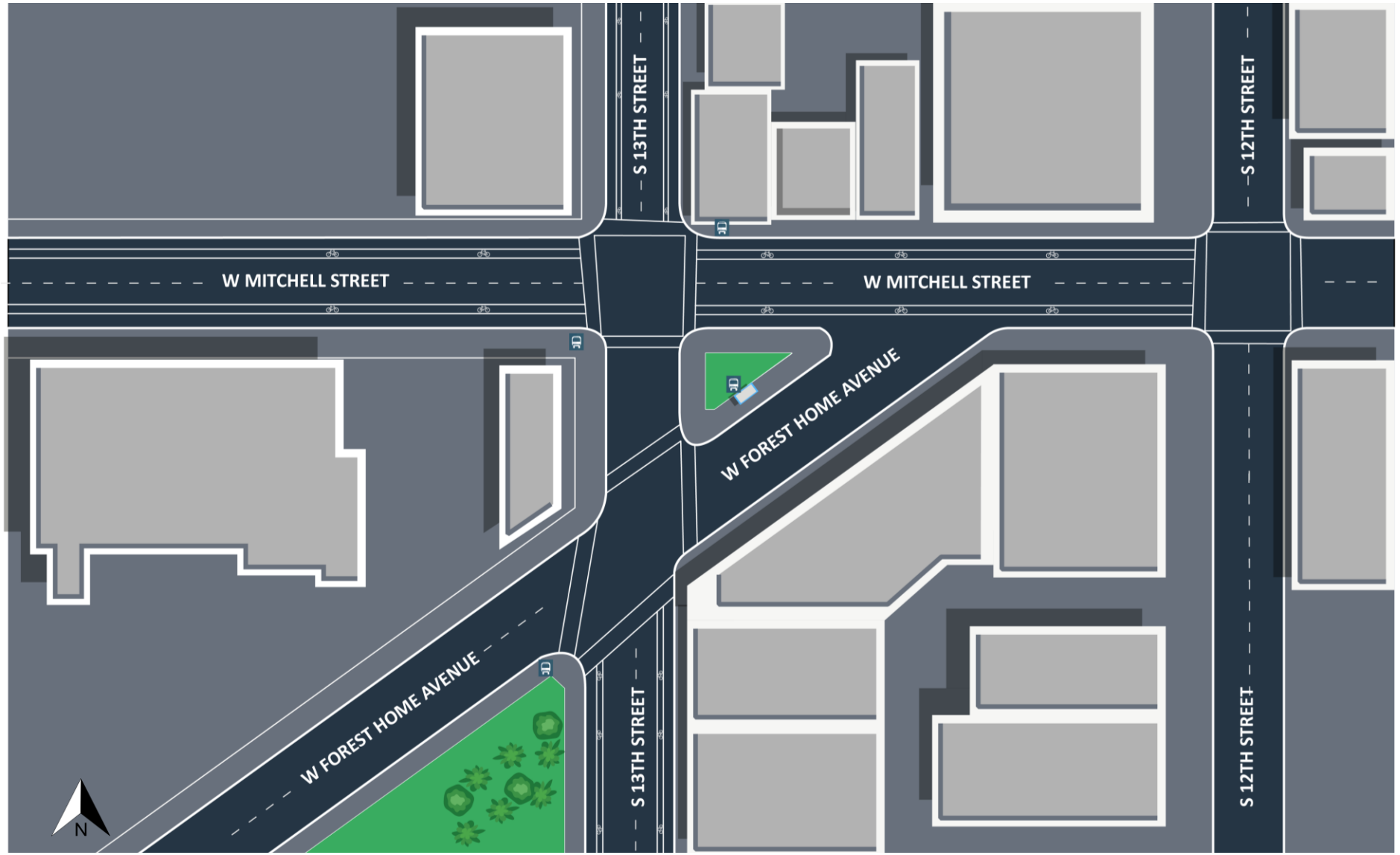
Curb Bumpouts
Source: https://cyclemoco.com/2012/04/dealing-with-curb-bumpouts/

Sunset Triangle Plaza
Source: https://www.rios.com/projects/sunset-triangle-plaza/

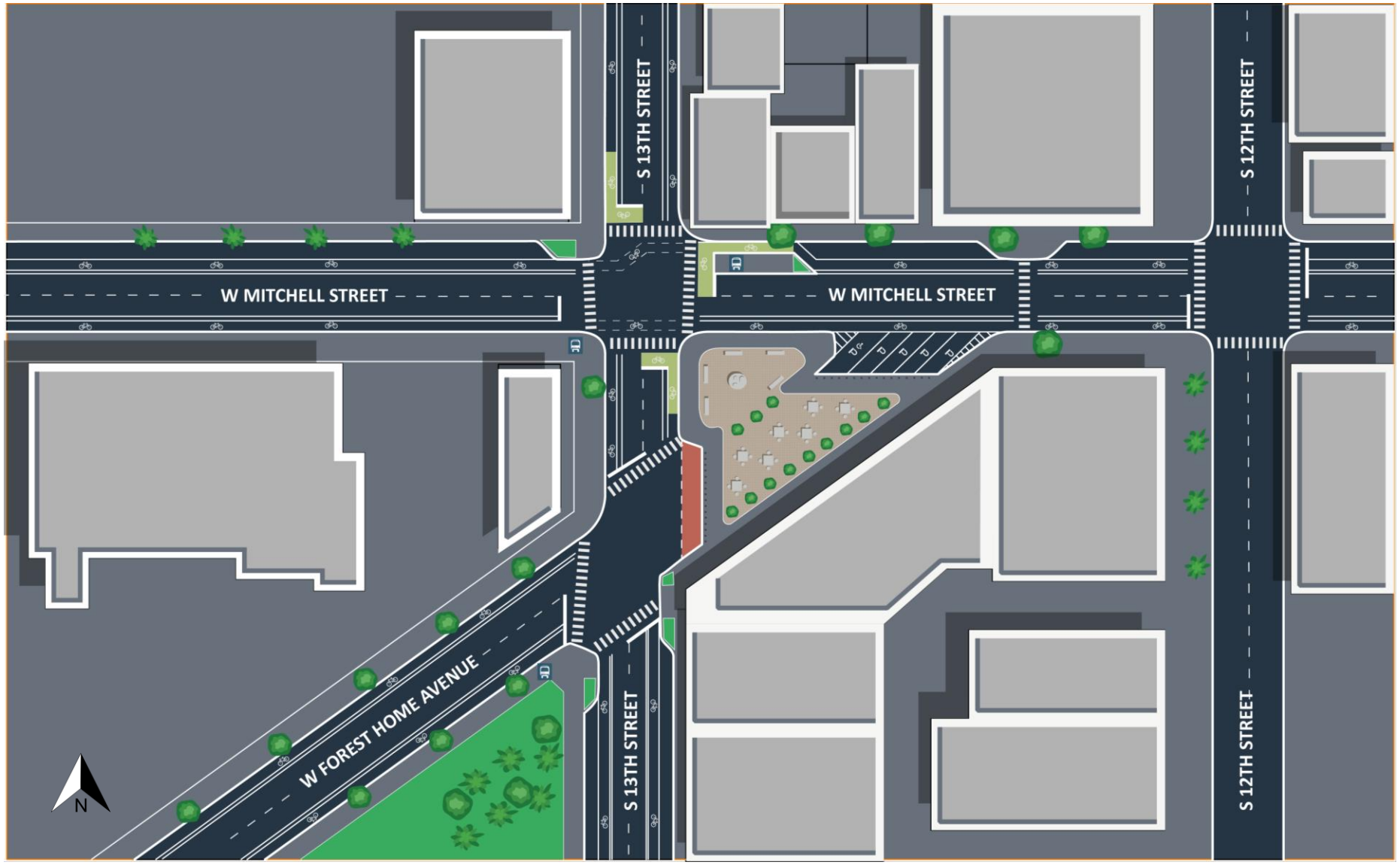
Thank you!
Questions?

Appendix

Existing Conditions



Proposed Redesign



Traffic Counts

Annual Traffic & Peak-hour Counts at Intersection			
Street Name	Daily	No. of Direction	Hourly per Direction*
Mitchell	4,400	2	220
Forest Home	3,600	2	180
13th Street	4,400	2	220

Source: WisDOT. https://wisdot.maps.arcgis.com/apps/webappviewer/index.html?id=2e12a4f051de4ea9bc865ec6393731f8

*Divided by 10 to estimate the peak-hour volume

Level of Traffic Stress Reference

The levels of traffic stress for bicycle for most existing roads are estimated using mixed traffic criteria

The levels of traffic stress for bicycle for redesigned roads without an adjacent parking lane are estimated using bike lanes and shoulders not adjacent to a parking lane

The levels of traffic stress for bicycle for redesigned roads alongside a parking lane are estimated using bike lanes alongside a parking lane

Mixed traffic criteria

Number of lanes	Effective ADT*	Prevailing Speed ≤ 20 mph	25 mph	30 mph	35 mph	40 mph	45 mph	50+mph
Unlaned 2-way street (no centerline)	0-750	LTS 1	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	751-1500	LTS 1	LTS 1	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4
	1501-3000	LTS 2	LTS 2	LTS 2	LTS 3	LTS 4	LTS 4	LTS 4
	3000+	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
1 thru lane per direction (1-way, 1-lane street or 2-way street with centerline)	0-750	LTS 1	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	751-1500	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4
	1501-3000	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
	3000+	LTS 3	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
2 thru lanes per direction	0-8000	LTS 3	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
	8001+	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4	LTS 4	LTS 4
3+ thru lanes per direction	any ADT	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4	LTS 4	LTS 4

* Effective ADT = ADT for two-way roads; Effective ADT = 1.5*ADT for one-way roads

Bike lanes and shoulders not adjacent to a parking lane

Number of lanes	Bike lane width	Prevailing Speed ≤ 25 mph	30 mph	35 mph	40 mph	45 mph	50+ mph
1 thru lane per direction, or unlaned	6+ ft	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	4 or 5 ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 4
2 thru lanes per direction	6+ ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	4 or 5 ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 4
3+ lanes per direction	any width	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4

Notes 1. If bike lane / shoulder is frequently blocked, use mixed traffic criteria.
2. Qualifying bike lane / shoulder should extend at least 4 ft from a curb and at least 3.5 ft from a pavement edge or discontinuous gutter pan seam
3.Bike lane width includes any marked buffer next to the bike lane.

Bike lanes alongside a parking lane

Number of lanes	Bike lane reach = Bike + Pkg lane width	Prevailing Speed ≤ 25 mph	30 mph	35 mph
1 lane per direction	15+ ft	LTS 1	LTS 2	LTS 3
	12-14 ft	LTS 2	LTS 2	LTS 3
2 lanes per direction (2-way)	15+ ft	LTS 2	LTS 3	LTS 3
2-3 lanes per direction (1-way)		LTS 2	LTS 3	LTS 3
other multilane		LTS 3	LTS 3	LTS 3

Notes 1. If bike lane is frequently blocked, use mixed traffic criteria.
2. Qualifying bike lane must have reach (bike lane width + parking lane width) ≥ 12 ft
3.Bike lane width includes any marked buffer next to the bike lane.

Source: Furth, P.G. "Level of Traffic Stress Criteria for Road Segments, Version 2.0," http://www.northeastern.edu/peter.furth/wp-content/uploads/2014/05/LTS-Tables-v2-June-1.pdf, June 2017.

LOS Calculation– Mitchell St. Existing - Westbound

The Motorized vehicle running speed for S 13th St. is speed limit on this street due to a lack of observed speed data. Observed on-street parking was almost occupied on a rainy day, we chose to use 90% to estimate occupied daily on-street parking. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	31.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	4.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	8.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	6.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.90
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	10.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	14.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	14.0
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	5.0
Continuous barrier (1 = Y; 0 = N)	B	0.0
Buffer area coefficient	f_b	1.0
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	7.5
Adjusted available sidewalk width	W_{as}	7.5
Sidewalk width coefficient	f_{sw}	3.8
Pedestrian LOS score for the roadway link	$I_{p,link}$	**1.31**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	31.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	31.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	220.0
Percent heavy vehicle volume (percentage)	P_{HV}	4.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	4.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	4.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	8.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	6.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.90
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	14.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	14.0
Effective width of outside through lane (feet)	W_e	8.0
Bicycle LOS score for the roadway link	$I_{b,link}$	**4.31**
Bicycle LOS grade for the roadway link	**Grade**	**E**

LOS Calculation– Mitchell St. Existing - Eastbound

The Motorized vehicle running speed for S 13th St. is speed limit on this street due to a lack of observed speed data. Observed on-street parking was partially occupied due to its availability, we chose to use 50% to estimate occupied daily on-street parking. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	31.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	4.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	7.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	5.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.50
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	10.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	14.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	14.0
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	5.0
Continuous barrier (1 = Y; 0 = N)	B	0.0
Buffer area coefficient	f_b	1.0
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	12.0
Adjusted available sidewalk width	W_{as}	10.0
Sidewalk width coefficient	f_{sw}	3.0
Pedestrian LOS score for the roadway link	$I_{p,link}$	**1.57**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	31.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	31.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	220.0
Percent heavy vehicle volume (percentage)	P_{HV}	4.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	4.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	4.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	7.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	5.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.50
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	14.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	14.0
Effective width of outside through lane (feet)	W_e	15.0
Bicycle LOS score for the roadway link	$I_{b,link}$	**3.50**
Bicycle LOS grade for the roadway link	**Grade**	**D**

LOS Calculation– Mitchell St. Redesign - Westbound

The Motorized vehicle running speed for S 13th St. is speed limit on this street. Observed on-street parking was almost occupied on a rainy day, we chose to use 90% to estimate occupied daily on-street parking. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	25.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	7.5
Width of the paved outside shoulder or parking area (feet)	W_{os}	0.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	-1.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.00
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	6.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	16.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	16.0
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	5.0
Continuous barrier (1 = Y; 0 = N)	B	1.0
Buffer area coefficient	f_b	5.4
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	12.0
Adjusted available sidewalk width	W_{as}	10.0
Sidewalk width coefficient	f_{sw}	3.0
Pedestrian LOS score for the roadway link	$I_{p,link}$	**1.48**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	25.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	25.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	220.0
Percent heavy vehicle volume (percentage)	P_{HV}	4.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	4.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	7.5
Width of the paved outside shoulder or parking area (feet)	W_{os}	8.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	6.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.90
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	17.5
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	17.5
Effective width of outside through lane (feet)	W_e	15.0
Bicycle LOS score for the roadway link	$I_{b,link}$	**3.15**
Bicycle LOS grade for the roadway link	**Grade**	**C**

LOS Calculation– Mitchell St. Redesign - Eastbound

The Motorized vehicle running speed for S 13th St. is speed limit on this street due to a lack of observed speed data. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	25.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	7.5
Width of the paved outside shoulder or parking area (feet)	W_{os}	0.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	-1.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.00
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	6.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	16.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	16.0
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	5.0
Continuous barrier (1 = Y; 0 = N)	B	1.0
Buffer area coefficient	f_b	5.4
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	12.0
Adjusted available sidewalk width	W_{as}	10.0
Sidewalk width coefficient	f_{sw}	3.0
Pedestrian LOS score for the roadway link	$I_{p,link}$	**1.48**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	25.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	25.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	220.0
Percent heavy vehicle volume (percentage)	P_{HV}	4.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	4.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	7.5
Width of the paved outside shoulder or parking area (feet)	W_{os}	0.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	-1.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.00
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	16.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	16.0
Effective width of outside through lane (feet)	W_e	23.5
Bicycle LOS score for the roadway link	$I_{b,link}$	**1.51**
Bicycle LOS grade for the roadway link	**Grade**	**A**

LOS Calculation – Forest Home St. Existing – Southwest Bound

The Motorized vehicle running speed for Forest Home St. is the 85th percentile speed from the Milwaukee Non-arterial Street Speed Studies provided by Dr. Robert Schneider. Observed on-street parking was nearly fully occupied, we chosen to use 80% to estimate occupied daily on-street parking. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	180.0
Width of the outside through lane (feet)	W_{ol}	11.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	0.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	8.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	6.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.80
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	10.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	11.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	11.0
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	6.0
Continuous barrier (1 = Y; 0 = N)	B	0.0
Buffer area coefficient	f_b	1.0
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	7.0
Adjusted available sidewalk width	W_{as}	7.0
Sidewalk width coefficient	f_{sw}	3.9
Pedestrian LOS score for the roadway link	$I_{p,link}$	**1.30**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	180.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	180.0
Percent heavy vehicle volume (percentage)	P_{HV}	4.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	4.0
Width of the outside through lane (feet)	W_{ol}	11.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	0.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	8.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	6.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.80
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	11.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	11.0
Effective width of outside through lane (feet)	W_e	3.0
Bicycle LOS score for the roadway link	$I_{b,link}$	**4.44**
Bicycle LOS grade for the roadway link	**Grade**	**E**

LOS Calculation – Forest Home St. Existing – Northeast Bound

The Motorized vehicle running speed for Forest Home St. is the 85th percentile speed from the Milwaukee Non-arterial Street Speed Studies provided by Dr. Robert Schneider. Observed on-street parking was nearly fully occupied, we chosen to use 80% to estimate occupied daily on-street parking. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	180.0
Width of the outside through lane (feet)	W_{ol}	11.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	0.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	9.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	7.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.80
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	10.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	11.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	11.0
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	6.0
Continuous barrier (1 = Y; 0 = N)	B	0.0
Buffer area coefficient	f_b	1.0
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	7.0
Adjusted available sidewalk width	W_{as}	7.0
Sidewalk width coefficient	f_{sw}	3.9
Pedestrian LOS score for the roadway link	$I_{p,link}$	**1.30**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	180.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	180.0
Percent heavy vehicle volume (percentage)	P_{HV}	4.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	4.0
Width of the outside through lane (feet)	W_{ol}	11.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	0.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	9.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	7.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.80
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	11.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	11.0
Effective width of outside through lane (feet)	W_e	4.0
Bicycle LOS score for the roadway link	$I_{b,link}$	**4.40**
Bicycle LOS grade for the roadway link	**Grade**	**E**

LOS Calculation – Forest Home St. Redesign – Southwest Bound

The Motorized vehicle running speed for Forest Home St. is the 85th percentile speed from the Milwaukee Non-arterial Street Speed Studies provided by Dr. Robert Schneider. Observed on-street parking was nearly fully occupied, we chosen to use 80% to estimate occupied daily on-street parking. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	180.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	6.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	7.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	5.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.80
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	10.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	16.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	16.0
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	6.0
Continuous barrier (1 = Y; 0 = N)	B	1.0
Buffer area coefficient	f_b	5.4
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	7.0
Adjusted available sidewalk width	W_{as}	7.0
Sidewalk width coefficient	f_{sw}	3.9
Pedestrian LOS score for the roadway link	$I_{p,link}$	**0.93**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	180.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	180.0
Percent heavy vehicle volume (percentage)	P_{HV}	4.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	4.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	6.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	7.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	5.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.80
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	16.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	16.0
Effective width of outside through lane (feet)	W_e	13.0
Bicycle LOS score for the roadway link	$I_{b,link}$	**3.64**
Bicycle LOS grade for the roadway link	**Grade**	**D**

LOS Calculation – Forest Home St. Redesign – Northeast Bound

The Motorized vehicle running speed for Forest Home St. is the 85th percentile speed from the Milwaukee Non-arterial Street Speed Studies provided by Dr. Robert Schneider. Observed on-street parking was nearly fully occupied, we chosen to use 80% to estimate occupied daily on-street parking. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	180.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	6.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	7.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	5.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.80
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	10.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	16.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	16.0
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	6.0
Continuous barrier (1 = Y; 0 = N)	B	1.0
Buffer area coefficient	f_b	5.4
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	7.0
Adjusted available sidewalk width	W_{as}	7.0
Sidewalk width coefficient	f_{sw}	3.9
Pedestrian LOS score for the roadway link	$I_{p,link}$	**0.93**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	180.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	180.0
Percent heavy vehicle volume (percentage)	P_{HV}	4.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	4.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	6.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	0.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	-1.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.80
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	16.0
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	16.0
Effective width of outside through lane (feet)	W_e	6.0
Bicycle LOS score for the roadway link	$I_{b,link}$	**4.30**
Bicycle LOS grade for the roadway link	**Grade**	**E**

LOS Calculation – S 13th St. Existing - Northbound

The Motorized vehicle running speed for S 13th St. is the 85th percentile speed from the Milwaukee Non-arterial Street Speed Studies provided by Dr. Robert Schneider. Observed on-street parking was less than 30% on a rainy day, we chosen to use 50% to estimate occupied daily on-street parking. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	36.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Width of the outside through lane (feet)	W_{ol}	10.5
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	5.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	8.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	6.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.50
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	10.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	15.5
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	15.5
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	0.0
Continuous barrier (1 = Y; 0 = N)	B	0.0
Buffer area coefficient	f_b	1.0
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	8.0
Adjusted available sidewalk width	W_{as}	8.0
Sidewalk width coefficient	f_{sw}	3.6
Pedestrian LOS score for the roadway link	$I_{p,link}$	**1.78**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	36.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	36.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	220.0
Percent heavy vehicle volume (percentage)	P_{HV}	10.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	10.0
Width of the outside through lane (feet)	W_{ol}	10.5
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	5.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	8.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	6.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.50
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	15.5
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	15.5
Effective width of outside through lane (feet)	W_e	18.5
Bicycle LOS score for the roadway link	$I_{b,link}$	**4.76**
Bicycle LOS grade for the roadway link	**Grade**	**E**

LOS Calculation – S 13th St. Existing - Southbound

The Motorized vehicle running speed for S 13th St. is the 85th percentile speed from the Milwaukee Non-arterial Street Speed Studies provided by Dr. Robert Schneider. Observed on-street parking was less than 30% on a rainy day, we chosen to use 50% to estimate occupied daily on-street parking. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	36.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Width of the outside through lane (feet)	W_{ol}	10.5
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	5.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	8.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	6.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.50
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	10.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	15.5
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	15.5
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	0.0
Continuous barrier (1 = Y; 0 = N)	B	0.0
Buffer area coefficient	f_b	1.0
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	11.5
Adjusted available sidewalk width	W_{as}	10.0
Sidewalk width coefficient	f_{sw}	3.0
Pedestrian LOS score for the roadway link	$I_{p,link}$	**1.76**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	36.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	36.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	220.0
Percent heavy vehicle volume (percentage)	P_{HV}	10.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	10.0
Width of the outside through lane (feet)	W_{ol}	10.5
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	5.0
Width of the paved outside shoulder or parking area (feet)	W_{os}	8.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	6.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.50
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	15.5
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	15.5
Effective width of outside through lane (feet)	W_e	18.5
Bicycle LOS score for the roadway link	$I_{b,link}$	**4.76**
Bicycle LOS grade for the roadway link	**Grade**	**E**

LOS Calculation – S 13th St. Redesign - Northbound

The Motorized vehicle running speed for S 13th St. is the current speed limit on this street. Observed on-street parking was less than 30% on a rainy day, we chosen to use 50% to estimate occupied daily on-street parking. Observed heavy vehicle volume was higher on 13th St, we estimated that to be 10% of total automobile volume. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	6.5
Width of the paved outside shoulder or parking area (feet)	W_{os}	7.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	5.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.50
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	10.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	16.5
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	16.5
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	2.0
Continuous barrier (1 = Y; 0 = N)	B	1.0
Buffer area coefficient	f_b	5.4
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	6.0
Adjusted available sidewalk width	W_{as}	6.0
Sidewalk width coefficient	f_{sw}	4.2
Pedestrian LOS score for the roadway link	$I_{p,link}$	**1.49**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	220.0
Percent heavy vehicle volume (percentage)	P_{HV}	10.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	10.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	6.5
Width of the paved outside shoulder or parking area (feet)	W_{os}	7.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	5.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.50
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	16.5
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	16.5
Effective width of outside through lane (feet)	W_e	20.0
Bicycle LOS score for the roadway link	$I_{b,link}$	**4.03**
Bicycle LOS grade for the roadway link	**Grade**	**D**

LOS Calculation – S 13th St. Redesign - Southbound

The Motorized vehicle running speed for S 13th St. is the current speed limit on this street. Observed on-street parking was less than 30% on a rainy day, we chosen to use 50% to estimate occupied daily on-street parking. Observed heavy vehicle volume was higher on 13th St, we estimated that to be 10% of total automobile volume. Peak-hour traffic volume was used as automobile flow rate, see the first appendix item for details.

Link-Based Pedestrian Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	6.5
Width of the paved outside shoulder or parking area (feet)	W_{os}	7.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder (feet)	W_{os}*	5.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.50
Effective width of combined bicycle lane and shoulder or parking area (feet)	W_1	10.0
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	16.5
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	16.5
Buffer width between roadway and sidewalk (ft) (use 0 if no SW)	W_{buf}	3.0
Continuous barrier (1 = Y; 0 = N)	B	1.0
Buffer area coefficient	f_b	5.4
Sidewalk width *(not including buffer)* (feet) (use 0 if doesn't exist)	W_{sw}	8.5
Adjusted available sidewalk width	W_{as}	8.5
Sidewalk width coefficient	f_{sw}	3.5
Pedestrian LOS score for the roadway link	$I_{p,link}$	**1.36**
Pedestrian LOS grade for the roadway link	**Grade**	**A**

Link-Based Bicycle Level of Service Evaluation		
		(Measure to the closest 0.5 feet)
Input Variable Description	**Variable**	**Measurement**
Number of through lanes in the study direction of travel	N_{th}	1.0
Character of cross-section (1 = divided by median; 0 = undivided)	D	0.0
Pavement condition rating (5 = excellent to 1 = poor)	P_c	4.0
Motorized vehicle running speed (miles/hour)	S_r	30.0
Adjusted motorized vehicle running speed (miles/hour)	S_{ra}	30.0
Midsegment automobile flow rate (vehicles/hour)	v_m	220.0
Adjusted midsegment demand flow rate (vehicles/hour)	v_{ma}	220.0
Percent heavy vehicle volume (percentage)	P_{HV}	10.0
Adjusted percent heavy vehicle volume (percentage)	P_{HVa}	10.0
Width of the outside through lane (feet)	W_{ol}	10.0
Width of the bicycle lane (feet) (use 0 if doesn't exist)	W_{bl}	6.5
Width of the paved outside shoulder or parking area (feet)	W_{os}	7.0
Curb is present (1 = yes; 0 = no)	C	1.0
Adjusted Width of the paved outside shoulder or parking area (feet)	W_{os}*	5.5
Proportion of on-street parking occupied (decimal)	p_{pk}	0.50
Total width of outside through lane, bicycle lane, & paved shoulder (feet)	W_t	16.5
Effective width of outside through lane, BL & shoulder as function of traffic volume (feet)	W_v	16.5
Effective width of outside through lane (feet)	W_e	20.0
Bicycle LOS score for the roadway link	$I_{b,link}$	**4.03**
Bicycle LOS grade for the roadway link	**Grade**	**D**

Redesign Cost Estimate Source Information

Recommended Improvement	Cost from Source	Original Unit	Source
Install Bench	$1,400.00	per bench	City of Alexandria, VA (2007)
Install Bus Stop Shelter	$7,500.00	per shelter	City of Alexandria, VA (2007)
Install Loading Zone sign	$75.00	per sign	City of Berkeley, CA (2009)
Install Bench	$4,500.00	per bench	City of Berkeley, CA (2009)
Plant Street Trees	$350.00	per tree	City of Berkeley, CA (2009)
Construct separated cycle track	$100,000 to $3,000,000	per mile	City of Milwaukee, WI (2010)
Install bicycle box	$2,500 to $5,000	per box	City of Milwaukee, WI (2010)
Install rectangular rapid flashing beacons	$10,000 to $20,000	per crosswalk	City of Milwaukee, WI (2019)
Upgrade existing signal to audible pedestrian signal	$5,000.00	per signal	City of Milwaukee, WI (2019)
Stripe high visibility crosswalks	$500 to $1,500	per crosswalk	City of Milwaukee, WI (2019)
Construct new ADA Curb Ramp	$1,000 to $2,000	per ramp	City of Milwaukee, WI (2019)
Install curb extension/bulbout (no drainage relocation)	$5,000 to $10,000	per bulbout	City of Milwaukee, WI (2019)
Restripe Loading and Parking Zone (Marking Parking Stall Paint)	$4.33	per linear foot	WI DoT (FY 2019)
Pave 6" Raised Plaza (Concrete Pavement 6-Inch)	$75.50	per square yard	WI DoT (FY 2021)
Construct new Curb and Gutter	$79,200.00	per mile	www.walkinginfo.org (2013)
Construct new Sidewalk (5' wide)	$290,000.00	per mile	www.walkinginfo.org (2013)

DoT Source Document: https://wisconsindot.gov/hccidocs/contracting-info/average-unit-price.pdf