CIVIL ENGINEERS

LAND SURVEYORS

LAND PLANNERS

11 Mile Streetscape Project - Option 2
11 Mile Road - John R Rd. to Lorenz St.
City of Madison Heights, Oakland County, MI
Engineer's Opinion of Probable Cost (Budget Purposes Only)

City of Madison Heights
300 W 13 Mile Road
Madison Heights, Michigan 48071

Engineer's Estimate
Nowak & Fraus Engineers
46777 Woodward Avenue
Pontiac, MI 48342

Roadway Length - 1,405 LF

Item	Quantity		*Unit Price	Amount
Section I - Pavement				
Earth Excavation	1,100	C.Y.	$28.00	$30,800.00
Pavement Removal	1,400	S.Y.	$15.00	$21,000.00
Curb & Gutter Removal	1,700	L.F.	$12.50	$21,250.00
Sidewalk Removal	2,250	S.Y.	$11.00	$24,750.00
Bumper Block Removal	11	EA.	$50.00	$550.00
Drive Approach Removal	300	S.Y.	$14.00	$4,200.00
Remove & Relocate Light Pole	10	EA.	$5,000.00	$50,000.00
Tree Removal	15	EA.	$2,000.00	$30,000.00
Root Grinding	15	EA.	$500.00	$7,500.00
Striping Removal	3,000	L.F.	$1.00	$3,000.00
8" Concrete Drive Approach w/ Integral C& G	175	S.Y.	$65.00	$11,375.00
9" Concrete Pavement	250	S.Y.	$70.00	$17,500.00
7" Blackened Concrete Pavement w/ Integral C& G	1,250	S.Y.	$70.00	$87,500.00
18" Concrete Curb	3,250	L.F.	$25.00	$81,250.00
4" Concrete Sidewalk	20,800	S.F.	$6.50	$135,200.00
6" Concrete Sidewalk Ramp	2,500	S.F.	$11.50	$28,750.00
8" Concrete Sidewalk	1,400	S.F.	$10.00	$14,000.00
Aggregate Base, 4" CIP - 21 AA	2,560	S.Y.	$15.00	$38,400.00
Aggregate Base, 6" CIP - 21 AA	1,650	S.Y.	$25.00	$41,250.00
24" White Overlay Cold Plastic (Crosswalk)	1,200	L.F.	$16.00	$19,200.00
Parking Lot Striping	1	LSUM	$2,000.00	$2,000.00
4" Polyurea Paint (White or Yellow)	1,300	L.F.	$2.00	$2,600.00
School Symbol Overlay Cold Plastic	2	EA.	$600.00	$1,200.00
LT Arrow Symbol Overlay Cold Plastic	1	EA.	$250.00	$250.00
Pedestrian Hawk Signal	1	LSUM	$150,000.00	$150,000.00
Silt Sack	21	EA.	$150.00	$3,150.00
Maintaining Traffic & Const. Signing	1	LSUM	$20,000.00	$20,000.00
Structure Adjustments	10	EA.	$500.00	$5,000.00
			Sub Total Section I:	**$851,675.00**

Item	Quantity		*Unit Price	Amount
Section II - Landscape				
Deciduous Canopy Tree (3" Cal.)	56	EA.	$900.00	$50,400.00
Ornamental Tree (2" Cal.)	44	EA.	$750.00	$33,000.00
Deciduous Shrub (7 Gal.)	289	EA.	$85.00	$24,565.00
Deciduous Shrub (5 Gal.)	125	EA.	$65.00	$8,125.00
Ornamental Grass (2 Gal.)	658	EA.	$30.00	$19,740.00
Perennial (1 Gal.)	492	EA.	$20.00	$9,840.00
Shredded Hardwood Mulch (3" Depth)	1,697	S.Y.	$5.00	$8,485.00
Organic Soil Mix - Turf (6" Depth)	12,806	C.F.	$2.00	$25,612.00
Organic Soil Mix - Plant Beds (12" Depth)	14,555	C.F.	$2.00	$29,110.00
Organic Soil Mix - Trees (24" Depth)	1,432	C.F.	$2.00	$2,864.00
Seed Lawn (Bed prep, fertilizer, seed & cover)	2,846	S.Y.	$1.75	$4,980.50
Gateway Signage Pier	1	LSUM	$40,000.00	$40,000.00
Bus Shelter	1	LSUM	$7,500.00	$7,500.00
Trash Receptacles	8	EA.	$1,000.00	$8,000.00
Benches	9	EA.	$1,000.00	$9,000.00
Bike Racks	12	EA.	$500.00	$6,000.00
Revised 4/5/2024			**Sub Total Section II:**	**$287,221.50**
*Design and Inspection is not included in the total. This represents anticipated construction cost for budgeting purposes only.			**Overall Total:**	**$1,138,896.50**

NF ENGINEERS

CIVIL ENGINEERS

LAND SURVEYORS

LAND PLANNERS

11 Mile Streetscape Project - Option 3 - (3 Lane Option)
11 Mile Road - John R Rd. to Lorenz St.
City of Madison Heights, Oakland County, MI
Engineer's Opinion of Probable Cost (Budget Purposes Only)

City of Madison Heights
300 W 13 Mile Road
Madison Heights, Michigan 48071

Engineer's Estimate
Nowak & Fraus Engineers
46777 Woodward Avenue
Pontiac, MI 48342

Roadway Length - 1,405 LF

Item	Quantity		*Unit Price	Amount
Section I - Pavement				
Earth Excavation	200	C.Y.	$28.00	$5,600.00
Pavement Removal	1000	S.Y.	$15.00	$15,000.00
Curb & Gutter Removal	200	L.F.	$12.50	$2,500.00
Sidewalk Removal	2,250	S.Y.	$11.00	$24,750.00
Bumper Block Removal	11	EA.	$50.00	$550.00
Drive Approach Removal	300	S.Y.	$14.00	$4,200.00
Tree Removal	15	EA.	$2,000.00	$30,000.00
Root Grinding	15	EA.	$500.00	$7,500.00
Striping Removal	3,000	L.F.	$1.00	$3,000.00
8" Concrete Drive Approach w/ Integral C& G	200	S.Y.	$65.00	$13,000.00
9" Concrete Pavement	350	S.Y.	$70.00	$24,500.00
18" Concrete Curb	675	L.F.	$25.00	$16,875.00
4" Concrete Sidewalk	22,500	S.F.	$5.00	$112,500.00
6" Concrete Sidewalk Ramp	6,650	S.F.	$11.50	$76,475.00
8" Concrete Sidewalk	1,200	S.F.	$10.00	$12,000.00
Aggregate Base, 4" CIP - 21 AA	3,240	S.Y.	$10.00	$32,400.00
Aggregate Base, 6" CIP - 21 AA	325	S.Y.	$25.00	$8,125.00
24" White Overlay Cold Plastic (Crosswalk)	900	L.F.	$16.00	$14,400.00
Parking Lot Striping	1	LSUM	$2,000.00	$2,000.00
4" Polyurea Paint (White or Yellow)	6,000	L.F.	$2.00	$12,000.00
School Symbol Overlay Cold Plastic	2	EA.	$600.00	$1,200.00
LT Arrow Symbol Overlay Cold Plastic	1	EA.	$250.00	$250.00
Pedestrian Crossing Signage	1	LSUM	$10,000.00	$10,000.00
Silt Sack	21	EA.	$150.00	$3,150.00
Maintaining Traffic & Const. Signing	1	LSUM	$20,000.00	$20,000.00
12" Dia. C-76 CL IV Sewer Pipe - Complete	400	L.F.	$130.00	$52,000.00
2' Dia. Inlet - Complete w/F&C	4	EA.	$3,000.00	$12,000.00
4' Dia. C.B. w/ Sump & Trap - Complete w/F&C	4	EA.	$5,000.00	$20,000.00
Sewer Tap	4	EA.	$1,000.00	$4,000.00
Structure Adjustments	10	EA.	$500.00	$5,000.00
			Sub Total Section I:	**$544,975.00**

Item	Quantity		*Unit Price	Amount
Section II - Landscape				
Deciduous Canopy Tree (3" Cal.)	57	EA.	$900.00	$51,300.00
Ornamental Tree (2" Cal.)	44	EA.	$750.00	$33,000.00
Deciduous Shrub (7 Gal.)	289	EA.	$85.00	$24,565.00
Deciduous Shrub (5 Gal.)	125	EA.	$65.00	$8,125.00
Ornamental Grass (2 Gal.)	583	EA.	$30.00	$17,490.00
Perennial (1 Gal.)	492	EA.	$20.00	$9,840.00
Shredded Hardwood Mulch (3" Depth)	1,697	S.Y.	$5.00	$8,485.00
Organic Soil Mix - Turf (6" Depth)	24,088	C.F.	$2.00	$48,176.00
Organic Soil Mix - Plant Beds (12" Depth)	10,508	C.F.	$2.00	$21,016.00
Organic Soil Mix - Trees (24" Depth)	1,432	C.F.	$2.00	$2,864.00
Seed Lawn (Bed prep, fertilizer, seed & cover)	5,353	S.Y.	$1.75	$9,367.75
Gateway Signage Pier	1	LSUM	$40,000.00	$40,000.00
Bus Shelter	1	LSUM	$7,500.00	$7,500.00
Trash Receptacles	8	EA.	$1,000.00	$8,000.00
Benches	9	EA.	$1,000.00	$9,000.00
Bike Racks	12	EA.	$500.00	$6,000.00
Revised 6/25/2024			**Sub Total Section II:**	**$304,728.75**
*Design and Inspection is not included in the total. This represents anticipated construction cost for budgeting purposes only.			**Overall Total:**	**$849,703.75**

Madison Heights - 11 Mile Streetscape - NFE Job N753

F&V Comments, December 18, 2023

1. **Lane width: We are proposing 10.5’ wide lanes with a 6’ wide center island**
   - We went with 10ft lanes and 8ft parking on Maple Rd in Birmingham. Lots of complaints about the difficulty parking. With 2 lanes at 10.5ft, I don’t see this as an issue here.
2. **Speed Limit**
   - Existing Speed limit 35 mph.
   - Can’t reduce speed limit without a speed and safety study.
   - Reducing the lane widths will help reduce the speeds, or reducing the number of lanes (4 to 2) would likely further reduce the speeds through the area.

3. **Proximity of center islands to intersections to allow proper turning movements, etc.**
   - You’ll want to run auto-turn at all of the intersections to make sure ingress and egress trucks can make the movements. One concern with the narrow median is vehicle will try to use it as a turn lane, but it’ll be too narrow and creates the potential for rear-end and sideswipe crashes.
   - One thing we ran into in Birmingham is that people continue to make U-turns at the narrow medians to access on-street parking, driveways and intersections. The medians are too narrow for turning movements, which then creates issues for landscaping and potential for crashes.
   - Would they consider narrowing to a two-lane section with median?

4. **Parallel parking space dimensions, 8’x22’ (need to maximize parking due to loss of ROW parking) Are the angled ends to be 45 degree?**
   - 45 degrees is OK.
   - Optional parking can be 20’ with 4’ boxes

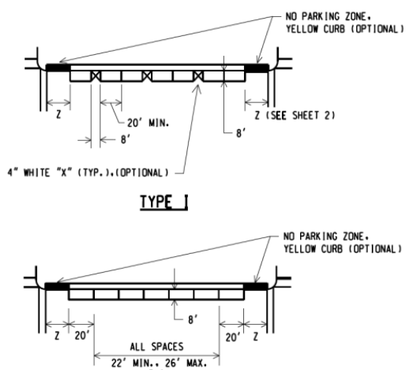

TABLE R211 ON-STREET PARKING SPACES

Total number of metered or designated parking spaces	Minimum required number of *accessible* parking spaces
1 to 25	1.
26 to 50	2.
51 to 75	3.
76 to 100	4.
101 to 150	5.
151 to 200	6.
201 and over	4 percent of total.

   - You’ll need to add ADA parking per PROWAG requirements. The number of spaces required is based upon the “block perimeter”. Since there is no commercial parking on the adjacent streets, you’ll need to add one ADA parking space per block, per side of the road.

5. **Proximity of parking spaces to the PC of crosswalks of the intersections. For both backup movements and forward movements.**
   - I would suggest adding crosswalks on all intersection legs.
   - I don’t see any location for a true mid-block crossing. But all of the intersections should have enhanced crosswalks.
   - No parking is permitted within 20’ feet of a marked crosswalk at unsignalized intersections per Michigan Vehicle Code. We’ve also had sight distance issues in Birmingham on S. Eton and have prohibited parking withing 30’ of the intersection or 20’ of the crosswalk, whichever is greater.

6. **The location of proposed new driveways where curb cuts were removed. The blue X is where existing driveways are located.**
   - I would recommend eliminating the driveway access within the intersection influence area. Recommended driveway access spacing is 115 feet minimum from the intersection.

7. **Mid-Block crossing treatments, design requirements (RRFB, HAWK) , cost estimate**
   - There isn’t a location for a true mid-block. There is no controlled crossing locations along the corridor, therefore an RRFB could be considered at either Townley or Delton
   - Locate at the intersection with the highest pedestrian demand or potential ped demand
   - RRFB cost is about 30k installed. HAWK is about 100-150k, this might be an option if there are more peds.

Other Notes:

- Have you talked to SEMCOG about the TAP grant? We recently applied for one in Birmingham and they provided feedback regarding what they would be looking for in the application and how best to get funded.
- Have you considered adding bike lanes?
- Ped countdown signals should be considered at Lorez, either as part of the TAP or a HISP

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SC315-G

Cabinet-Based Rectangular Rapid Flashing Beacon

carmanah®

Rectangular rapid flashing beacons (RRFBs) improve pedestrian safety by increasing yield rates to 72-96% at crosswalks.*

- The benchmark for RRFBs, the SC315-G meets MUTCD requirements, including IA-21, and is Buy America compliant
- Audible pushbutton or passive pedestrian activation
- Solar ~~or AC-powered~~
- Energy Balance Report™ (EBR) prepared for every location to ensure battery longevity

Superior Design and Technology

The SC315-G is a cabinet-based system with a separate, high-power solar panel. This design enables the SC315-G to work with audible pushbutton stations, passive activation sensors, and remote monitoring, as well as operate at higher intensities and increased activations in challenging environments. MUTCD interim approval IA-21 flash pattern and multiple configurations enable the SC315-G to handle all crosswalk applications.

Easy Installation

All components, including the battery or AC power supply, Energy Management System (EMS) and optional audible pushbutton controller are housed in a compact, lockable, purpose-built enclosure. It also incorporates a wire routing and termination system, and all components are wired at the factory for an efficient installation.

Advanced User Interface

The SC315-G comes with an on-board user interface for quick configuration and status monitoring. It allows for simple in-the-field adjustment of flash pattern, duration, intensity, ambient auto adjust, night dimming, and many more. Settings are automatically sent wirelessly to all units in the system.

Compatibility

Compatible with Carmanah RRFBs and the R820-E, R820-F, and R820-G circular beacons. Interchange solar and AC power models within the same application.

Reliable

Designed with Carmanah's industry-leading solar modeling tools to provide dependable year-after-year operation. We prepare an Energy Balance Report (EBR) for every location.

Trusted for 20+ Years

With thousands of installations, Carmanah's systems are the benchmark in traffic applications and other transportation applications worldwide.

* U.S. Department of Transportation Federal Highways Administration, Publication No. FHWA-HRT-10-043 - "Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multilane Uncontrolled Crosswalks"

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SC315-G

Cabinet-Based Rectangular Rapid Flashing Beacon

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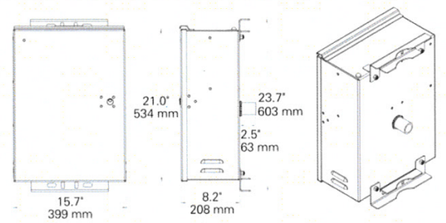
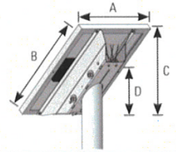
CABINET DIMENSIONS

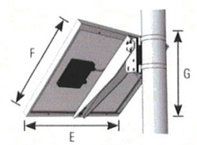


SOLAR PANEL MOUNTING

4.5" Diameter Round Top of Pole Mount



Side of Pole Mount

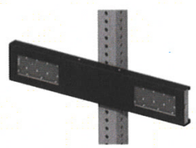


PANELS*	A	B	C	D	E	F	G
20 W	-	-	-	-	13.6" (345 mm)	18.5" (470 mm)	13.8" (350 mm)
50 W	21.2" (538 mm)	26.3" (668 mm)	19.6" (497 mm)	10.0" (254 mm)	26.3" (668 mm)	21.2" (538 mm)	16.0" (405 mm)
80 W	30.7" (780 mm)	26.5" (672 mm)	19.7" (500 mm)	10.0" (254 mm)	30.7" (780 mm)	26.5" (672 mm)	19.7" (500 mm)

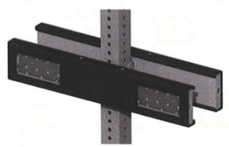
*** Carmanah will conduct a site assessment and provide an Energy Balance Report™ to determine the correct solar panel and battery size.**

LIGHT BAR CONFIGURATION

Uni-directional Configuration



Bi-directional Configuration

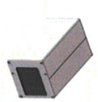


ACTIVATION OPTIONS

Standard Pushbutton

Audible Pushbutton Station

Passive Activation Sensor



BEACON SPECIFICATIONS

Optical	MUTCD interim approval IA-21 and MUTCDC compliant
	Purpose-built light bar optics = maximum efficiency and no stray light Exceeds SAE J595 class 1 intensity by 2.5 to 3x when used as recommended Meets SAE J578 chromaticity
	3 in (76 mm) x 7 in (178 mm) clear, UV-rated polycarbonate lens with yellow LEDs
	High-power LEDs: +90% lumen maintenance (L90) based on IES LM-80
	Side-emitting pedestrian confirmation LEDs
	Independent, stainless steel mounting brackets make back-to-back installation simple and enable in-field aiming for maximum effectiveness
	Yellow, black, or green powder coated light bar covers

SYSTEM SPECIFICATIONS

On-Board User Interface (OBUI)	Adjustable system settings with auto-scrolling LED display on our latest EMS
	System test, status, and fault detection: battery, solar, button, beacon, radio, day/night
	Flash patterns: RFB (WW+S), RFB1 (WW+S legacy), RFB2 (WSDOT), 0.5 sec. alternating (MUTCD), 0.5 sec. unison (MUTCD), 0.5 sec. x3 alternating (MUTCD), 0.1 sec. unison, 0.25 sec. unison, 0.1 sec. x3 quick flashes unison, 0.1 sec. x3 quick flashes alternating, steady on
	Input: momentary for pushbutton activation, normally open switch, normally closed switch
	Flash duration: 5 sec. to 1 hr.
	Intensity setting: 20 to 1400 mA for multiple RRFBs, circular beacons, or LED enhanced signs
	Nighttime dimming: 10 to 100% of daytime intensity
	Ambient Auto Adjust: increases intensity during bright daytime
	Automatic Light Control: reduces intensity if the battery is extremely low
	Temperature correction: yellow beacons
	Calendar: internal time clock function
	Radio settings: enable/disable, selectable channel from 1 to 14
	Output: enabled when beacons flashing daytime and nighttime, or nighttime only E.g., for relay control of overhead lighting
	Activation counts and data reporting via OBUI or optional USB connection
Beacon Communication	Encrypted, wireless radio with 2.4 GHz mesh technology
	Wireless update of settings from any unit to all systems on the same radio channel
	User-selectable multiple channels to group different beacons and ensure a robust wireless signal
	Communicates with all other Gen III radio-enabled systems including our R820-E, -F, and -G circular beacons
	Instantaneous wireless activation: <150 ms
	Wireless range: 1000 ft (305 m)
	Integrated, vandal-resistant antenna
Power System	Solar or AC-powered
	AC: 100-240 VAC input, 6-14 AWG Replaceable AC-DC power supply, circuit breaker, terminal block wiring
Energy Collection	20, 50, or 80 W high-efficiency photovoltaic solar panel
	45 deg tilt for optimal energy collection
	Maximum Power Point Tracking with Temperature Compensation (MPPT-TC) battery charger for optimal energy collection in all solar and battery conditions
Energy Storage	12 V battery system with multiple sizes: 35, 55, 100 Ahr.
	Replaceable, recyclable, sealed, maintenance-free, best-in-class AGM batteries offer the widest temperature range and longest life
	Battery design life: +5 yrs.
Cabinet Construction	Weatherproof, gasketed enclosure with vents for ambient air transfer (NEMA 3R)
	Lockable, hinged door with #2 lock Optional padlockable latch
	Corrosion-resistant aluminum with stainless steel hardware
	Raw aluminum finish or yellow, black, or green powder coated
	Prewired to minimize installation time
	High-efficiency optics and EMS = the most compact, lightweight system
Environmental	-35 to 165° F (-37 to 74° C) system operating temperature
	-40 to 140° F (-40 to 60° C) battery operating temperature
	150 mph (241 kph) wind speed as per AASHTO LTS-6
Activation	Pushbutton: ADA-compliant, piezo-driven with visual LED and two-tone audible confirmation
	Audible pushbutton station: ADA-compliant, piezo-driven with visual LED and customizable voice message confirmation
	Passive activation: microwave-based sensor detects pedestrian
Warranty	**5-year limited warranty, excluding batteries**

ADA | ITE | IMSA Your Partner in PUBLIC SAFETY | MUTCD IA-21 | Buy America Compliant | Buy American Compliant

Specifications subject to local environmental conditions, and may be subject to change.

All Carmanah products are manufactured in facilities that are certified to ISO quality standards.

Document: SPEC_TRA_SC315-G_RevB

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SC315-G

RECTANGULAR RAPID FLASHING BEACON

carmanah® Traffic

MUTCD-compliant, pedestrian-activated warning beacon for uncontrolled marked crosswalks

- Improve pedestrian safety by increasing driver yield rates
- Passive activation: microwave-based sensor detects pedestrian
- Audible push button station
- Solar power performance even in partially shaded applications
- Solar and AC-powered models wirelessly communicate and can be used together in the same application
- Meets and exceeds MUTCD requirements, including IA-21

RRFBs have been found to provide vehicle yielding rates between 72 and 96 percent for crosswalk applications, including 4 lane roadways with average daily traffic (ADT) exceeding 12,000*.

Superior Design and Technology
The SC315-G is a cabinet-based system with a separate, high-power solar panel. This design enables the SC315-G to work with audible push button stations, passive activation sensors, and remote monitoring, as well as operate at higher intensities and increased activations in challenging environments. MUTCD interim approval IA-21 flash pattern and multiple configurations enable the SC315-G to handle all crosswalk applications.

Easy Installation
All components, including the battery or AC power supply, Energy Management System (EMS) and optional audible push button controller are housed in a compact, lockable, purpose-built enclosure. It also incorporates a wire routing and termination system, and all components are wired at the factory for an efficient installation.

Advanced User-Interface
The SC315-G comes with an on-board user interface for quick configuration and status monitoring. It allows for simple in-the-field adjustment of flash pattern, duration, intensity, ambient auto adjust, night dimming, and many more. Settings are automatically sent wirelessly to all units in the system.

Compatibility
Compatible with Carmanah RRFBs and the R820-E, R820-F, and R820-G circular beacons. Interchange solar and AC power models within the same application.

Trusted
With thousands of installations, Carmanah's beacons are the benchmark in traffic applications and other transportation applications worldwide.

WE SIMPLIFY PLANNING.
Contact us to get your Energy Balance Report and purchase specifications.

1.844.412.8395
traffic@carmanah.com
carmanahtraffic.com

REPRESENTED IN YOUR REGION BY:

* U.S. Department of Transportation Federal Highways Administration, Publication No. FHWA-HRT-10-043 - "Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multilane Uncontrolled Crosswalks"

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SC315-G

RECTANGULAR RAPID FLASHING BEACON

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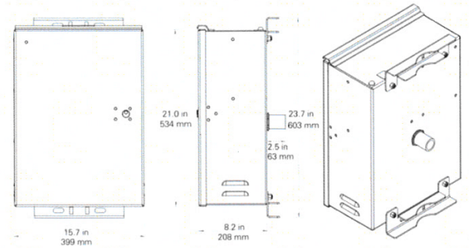
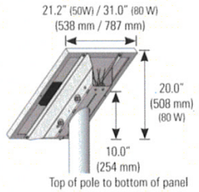
carmanah® Traffic

CABINET DIMENSIONS

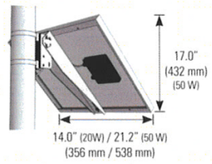


SOLAR PANEL MOUNTING

~~4.5" Diameter Round Top of Pole Mount (50 W and 80 W panels)~~

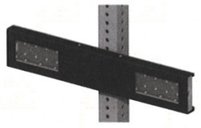


~~Side of Pole Mount (20 W, 50 W, and 80 W panels)~~

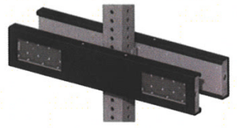


LIGHT BAR CONFIGURATION

~~Uni-directional Configuration~~



~~Bi-directional Configuration~~

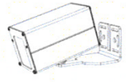


ACTIVATION OPTIONS

Push Button

~~Audible Push Button Station~~

~~Passive Activation Sensor~~



Specifications subject to local environmental conditions, and may be subject to change.
All Carmanah products are manufactured in facilities that are certified to ISO quality standards.
US Patent No 6,573,659, Other patents pending.
"Carmanah" and Carmanah logo are trademarks of Carmanah Technologies Corp.

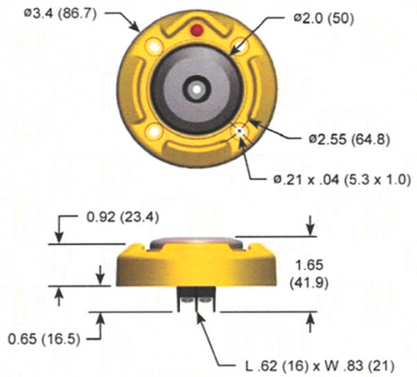
Document: SPEC_TRA_SC315-G_RevA

On-Board User Interface (OBUI)	Adjustable system settings with auto-scrolling LED display on our latest EMS
	System test, status, and fault detection: battery, solar, button, beacon, radio, day/night
	Flash patterns: RFB1 (WW+S), RFB2 (WSDOT), 0.5 sec. alternating (MUTCD), 0.5 sec. unison (MUTCD), 0.1 sec. unison, 0.25 sec. unison, 0.1 sec. x3 quick flashes unison, 0.1 sec. x3 quick flashes alternating
	Input: momentary for push button activation, normally open switch, normally closed switch
	Flash duration: 5 sec. to 1 hr.
	Intensity setting: 20 to 1400 mA for multiple RRFBs, circular beacons, or LED enhanced signs
	Nighttime dimming: 10 to 100% of daytime intensity
	Ambient Auto Adjust: increases intensity during bright daytime
	Automatic Light Control: reduces intensity if the battery is extremely low
	Temperature correction: yellow or red beacons
	Calendar: internal time clock function
	Radio settings: enable/disable, selectable channel from 1 to 14
	Output: enabled when beacons flashing daytime and nighttime, or nighttime only
	Activation counts and data reporting via OBUI or optional USB connection
Optical	MUTCD interim approval IA-21 and MUTCDC compliant
	Purpose-built light bar optics = maximum efficiency and no stray light Exceeds SAE J595 class 1 intensity by 2.5 to 3x when used as recommended Meets SAE J578 chromaticity
	3 in (76 mm) x 7 in (178 mm) clear, UV-rated polycarbonate lens with yellow LEDs
	High-power LEDs: +90% lumen maintenance (L90) based on IES LM-80
	Side-emitting pedestrian confirmation LEDs
	Independent, stainless steel mounting brackets make back-to-back installation simple and enable in-field aiming for maximum effectiveness
	~~Yellow,~~ black, ~~or green~~ powder coated light bar covers
Connectivity	Encrypted, wireless radio with 2.4 GHz mesh technology
	Wireless update of settings from any unit to all systems on the same radio channel
	User-selectable multiple channels to group different beacons and ensure a robust wireless signal
	Communicates with all other Gen III radio-enabled systems including our R820-E, -F, and -G circular beacons
	Instantaneous wireless activation: <150 ms
	Wireless range: 1000 ft (305 m)
	Integrated, vandal-proof antenna
Power System	~~Solar or~~ AC-powered
	AC: 90-264 VAC input, 6-14 AWG Replaceable AC-DC power supply, circuit breaker, terminal block wiring
Energy Collection	~~20, 50, or 80 W high-efficiency photovoltaic solar panel~~
	~~45 deg tilt for optimal energy collection~~
	~~Maximum Power Point Tracking with Temperature Compensation (MPPT-TC) battery charger for optimal energy collection in all solar and battery conditions~~
Energy Storage	~~12 V battery system with multiple sizes: 33, 35, 75, 100 Ahr.~~
	~~Replaceable, recyclable, sealed, maintenance-free, best-in-class AGM batteries offer the widest temperature range and longest life~~
	~~**Battery design life:** >5 yrs.~~
Cabinet Construction	Weatherproof, gasketed enclosure with vents for ambient air transfer (NEMA 3R)
	Lockable, hinged door with #2 lock
	Corrosion-resistant aluminum with stainless steel hardware
	Raw aluminum finish or yellow, black, or green powder coated
	Prewired to minimize installation time
	High-efficiency optics and EMS = the most compact, lightweight system
Environmental	-40 to 165° F (-40 to 74° C) system operating temperature
	~~-40 to 162° F (-40 to 72° C) battery operating temperature~~
	150 mph (241 kph) wind speed as per AASHTO LTS-6
Activation	**Push button:** ADA-compliant, piezo-driven with visual LED and two-tone audible confirmation
	~~**Audible push button station:** ADA-compliant, piezo-driven with visual LED and customizable voice message confirmation~~
	~~**Passive activation:** microwave-based sensor detects pedestrian~~
Warranty	**5-year limited warranty**

POLARA ENGINEERING INC. 9153 STELLAR CT., CORONA, CA 92883 (888) 340-4872

BDSP-014 – BullDog III Series Vandal Resistant ADA Compliant Push Button for TS1 Cabinets with Relay Isolators

This button is a highly vandal resistant button with essentially no moving parts. It is pressure activated, but can withstand an impact from a baseball bat or hammer. When the switch activates, you hear a beep and the LED will flash. When the button is released you will hear a second beep. BDSP-014 meets the relay driving requirements of older electromechanical relay based PED isolators found in some TS1 Cabinets.



Body Material: Aluminum, Powder Coated

Button material: 316 Stainless Steel

Piezo Driven Solid State Switch:
- Operating Force: 3.0 lbs. Maximum
- Operating Temperature: -30°F to +165°F (-34°C to +74°C)
- Operating Voltage: 12-36 VDC, 9-25 VAC RMS (18 VDC Typ.)
- MTBF: 8,800,000 hours Typ.
- Switch Operating Life: Greater than 300 million operations
- "Off" Current: 15µA Typ.
- "On" Resistance: 5Ω Typ.
- Maximum "On" Current: 350 mA (over-current protected) Typ.
- Maximum "On" Time: 11 sec. Typ.
- Debounce Time: 85 ms Typ.

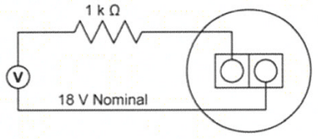
LED Operation: Approx 0.025 sec. LED flash each time button is pressed.

LED Specifications:
- Luminous Intensity: 0.3 Lux @ 1meter Minimum (Red)
- Viewing Angle: 155° Typ.

Beeper:
- Volume: 68 dB @ 1 meter Typ.
- Beep on Press: 2.6 kHz
- Beep on Release: 2.3 kHz
- Beep Length: 50 ms Typ.

Warranty: 5 Years, free from manufacturers defects

Suggested Test Circuit



Design Compliance

Test Type	Compliance
Activation Force	MUTCD 2009 – 4E
Temperature and Humidity	NEMA TS 2
Transient Voltage Protection	NEMA TS 2
Transient Suppression	IEC 61000-4-4, IEC 61000-4-5
Lightning and Power Protection	GR-1089-CORE, 6000V-400A 25 reps, 60VAC-15 minutes
Electronic Noise	FCC Title 47, Part 15, Class A
Mechanical Shock and Vibration	NEMA TS 2
Ingress of Water	NEMA 250 – 6P, Rain, Snow, etc.
Ingress of Water	NEMA 250 – 6P, Submersion
Salt Spray and Corrosion	NEMA 250 – 6P
Ingress of Foreign Objects	NEMA 250 – 6P
Electrical Reliability	NEMA TS 4

Notes:
1) Applicable sections only of referenced standards.
2) All specifications subject to change without notice.

Product Ordering Information

BDSP-014-B Black Body
BDSP-014-G Green Body
BDSP-014-Y Yellow Body

BDSP-014-Y model shown.
Dimensions are in inches (millimeters).

 Doc. BDSP-014 Rev. C-23706 06/14/12 Page 1 of 2 www.polara.com

RATHCO SAFETY SUPPLY, INC.

36" X 36"
FLUORESCENT YELLOW-GREEN
W11-2

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

MEMO

VIA EMAIL BBrickel@nfe-engr.com

To: **Brad Brickel**
Nowak & Fraus Engineers

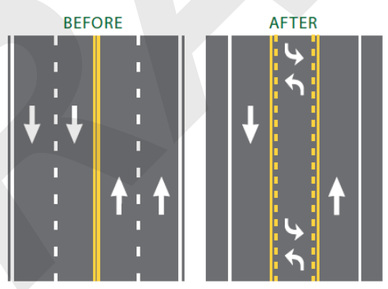
From: **Julie M. Kroll, PE, PTOE**
Paul Bonner, EIT
Fleis & VandenBrink

Date: **May 28, 2024**

Re: **Road Diet Corridor Study, 11 Mile Road**
Madison Heights, Michigan
Traffic Engineering Study

1 INTRODUCTION

This memorandum presents the results of the Road Diet Traffic Study for the 11 Mile Road corridor through the City of Madison Heights, Michigan. The City is evaluating the possibility of a road diet through the City limits, from NB Stephenson Highway to Dequindre Road, to change the existing 4-Lane sections to 3-Lane sections, thereby providing a "road diet" through the corridor. The potential road diet will provide a three-lane cross-section, with one (1) lane in each direction and a center two-way left-turn lane (TWLTL).



The primary goal of the proposed road diet is improved safety and reduce traffic crashes along the corridor. The project limits are shown on the attached **Figure 1** and additional roadway information is summarized in **Table 1**.

Table 1: Existing Roadway Information (11-Mile Road)

11 Mile Road (NB Stephenson Highway to Dequindre Road)	
Lane	4-lanes (2 lanes in each direction)
Average Daily Traffic (2023)	13,360 vpd
Functional Classification	Minor Arterial
Posted Speed Limit	35 mph

27725 Stansbury Boulevard, Suite 195
Farmington Hills, MI 48334
P: 248.536.0080
F: 248.536.0079
www.fveng.com

This study has been completed to examine the traffic operations and capacity, safety, and geometric needs of the corridor, including the following study intersections on 11 Mile Road:

1. Dequindre Road
2. Hales Street
3. Lorenz Street
4. John R Road
5. Hampden Street
6. NB Stephenson Highway

The study includes the evaluation of the existing intersection operations and recommendations, including safety improvements, signal timing optimization along 11 Mile Road, geometric improvements, and other measures that would be effective in improving the operations along the roadway corridor.

This evaluation included the following analyses:

Existing Conditions (2024)	Road Diet Opening Day (2024)	Road Diet Horizon Year (2044)
• Existing Traffic Volumes • 4-Lanes Undivided • Existing Geometry	• Existing Traffic Volumes • 3-Lanes (Center TWLTL) • Proposed Geometry	• Horizon Year Traffic Volumes • 3-Lanes (Center TWLTL) • Proposed Geometry

The purpose of this analysis is to determine the feasibility of a road diet for this study corridor and to determine what improvements, if any, are recommended to accommodate such a road diet. The scope of this study was developed based on Fleis & VandenBrink's (F&V) knowledge of the study area, understanding of the development program, accepted traffic engineering practices and information published by the Institute of Transportation Engineers (ITE). The study analyses were completed using Synchro/SimTraffic (Version 11). Sources of data for this study include F&V subconsultant Quality Counts, LLC (QC), Michigan Department of Transportation (MDOT), Road Commission for Oakland County (RCOC), Monroe County Road Commission (MCRC), and ITE.

2 DATA COLLECTION

The existing weekday turning movement traffic volume data was collected by F&V subconsultant Quality Counts, LLC (QC) on Wednesday, April 24, 2024. Intersection Turning Movement Counts (TMC) were collected during the weekday AM (7:00 AM to 9:00 AM), MD (11:00 AM to 1:00 PM), School PM (2:00 PM to 4:00 PM), and PM (4:00 PM to 6:00 PM) peak periods at all study intersections. The data collection included Peak Hour Factors (PHFs), pedestrian volumes, and commercial trucks percentages which were used in the analysis in accordance with MDOT Electronic Traffic Control Devices guidelines. The peak hours at each intersection were utilized and through volumes were carried along the main study roadways and were balanced upwards through the study roadway network in accordance with MDOT guidelines. Additionally, at locations where access is provided between study intersections, "dummy node" intersections were used in the traffic modeling to account for sink and source volumes. Therefore, the traffic volumes utilized in the analysis and shown on the attached traffic volume figures may not match the raw traffic volumes shown in the data collection.

F&V collected an inventory of existing lane use and traffic controls, as shown on the attached **Figure 2**. Additionally, F&V obtained the current signal timing permits for the signalized study intersections from RCOC and MCRC. The existing 2024 peak hour traffic volumes used in the analysis are shown on the attached **Figure 3**. All applicable background data referenced in this memorandum is attached.

3 EXISTING (2024) CONDITIONS ANALYSIS

The existing AM, MD, School PM, and PM peak hour vehicle delays and Levels of Service (LOS) were calculated at the study intersections using Synchro (Version 11) traffic analysis software. This analysis was performed based on the existing peak hour traffic volumes sown on the attached **Figure 3**, the existing lane use and traffic control shown on the attached **Figure 2**, and methodologies presented in the *Highway Capacity Manual 6th Edition* (HCM6). *Note: The NB Stephenson Highway & 11 Mile Road intersection has a northbound shared through/left-turn lane, which is not supported by the HCM6 methodology; therefore, the HCM 2000 methodology was determined to be more appropriate for use at this study intersection.*

All of the signalized study intersections (with the exception of 11 Mile Road & NB Stephenson Highway and 11 Mile Road & Dequindre Road), operate on RCOC's Sydney Coordinated Adaptive Traffic System (SCATS). Therefore, the baseline timings were input, and the signal timings were optimized for each scenario studied at each of these SCATS intersections, in order to reflect the real time optimizations that are occurring to accommodate the actual traffic volumes observed by the approach lane detectors.

Descriptions of LOS "A" through "F", as defined in the HCM6, are attached. Typically, LOS D is considered acceptable, with LOS A representing minimal delay and LOS F indicating failing conditions. Additionally, SimTraffic network simulations were reviewed to evaluate network operations and vehicles queues. The results of the existing conditions analysis are attached and summarized in **Table 2**.

The results of the existing conditions analysis indicates that all approaches and movements at the study intersections are currently operating acceptably, at LOS D or better during the AM, MD, School PM, and PM peak periods with the following exceptions:

Dequindre Road & 11 Mile Road

- Several intersection approaches and movements currently operate a LOS E or F during the peak periods.
- Review of the operations shows that the signal currently operates with a 180 second cycle length. Therefore, it is not unreasonable for vehicles to experience high delays. Review of SimTraffic network simulations indicates that the majority of vehicle queue were observed to be serviced within each cycle length throughout the study corridor.

Table 2: Existing Geometry (4-Lanes) Intersection Operations

11 Mile Road Intersection		Control	Approach	Existing Conditions (2024)							
				AM Peak		MD Peak		School PM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Dequindre Road	Signalized	EBL	136.4	F	69.7	E	151.2	F	133.0	F
			EBTR	87.0	F	47.9	D	84.4	F	85.2	F
			WBL	59.7	E	35.9	D	68.1	E	72.0	E
			WBT	85.4	F	36.2	D	97.5	F	81.9	F
			WBTR	112.3	F	55.0	D	100.2	F	93.3	F
			NBL	42.3	D	25.8	C	50.5	D	51.9	D
			NBTR	81.1	F	48.5	D	71.6	E	71.5	E
			SBL	49.5	D	29.9	C	62.7	E	57.9	E
			SBT	71.5	E	41.6	D	66.7	E	62.9	E
			SBR	46.2	D	27.6	C	41.0	D	34.6	C
			Overall	**80.0**	**E**	**44.6**	**D**	**77.5**	**E**	**73.6**	**E**
2	Hales Street	Signalized	EBTL	0.3	A	1.4	A	12.2	B	2.0	A
			EBTR	0.3	A	1.5	A	12.7	B	2.1	A
			WBTL	3.0	A	1.4	A	3.8	A	1.7	A
			WBTR	3.0	A	1.4	A	3.9	A	1.8	A
			NB	33.5	C	38.4	D	32.3	C	37.6	D
			SB	36.8	D	38.4	D	36.4	D	38.6	D
			Overall	**5.2**	**A**	**2.8**	**A**	**10.3**	**B**	**3.1**	**A**
3	Lorenz Street	Signalized	EBTL	0.2	A	0.2	A	0.4	A	0.4	A
			EBTR	0.3	A	0.2	A	0.4	A	0.5	A
			WBTL	12.9	B	0.2	A	0.6	A	0.4	A
			WBTR	13.0	B	0.2	A	0.7	A	0.5	A
			NB	31.2	C	37.1	D	31.9	C	35.1	D
			SB	35.6	D	38.6	D	36.1	D	37.5	D
			Overall	**12.4**	**B**	**3.6**	**A**	**4.3**	**A**	**3.6**	**A**

11 Mile Road Intersection		Control	Approach	Existing Conditions (2024)							
				AM Peak		MD Peak		School PM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
4	John R Road	Signalized	EBL	38.6	D	36.1	D	42.6	D	37.3	D
			EBT	36.6	D	34.8	C	34.1	C	43.0	D
			EBTR	37.3	D	35.2	D	34.7	C	44.1	D
			WBL	33.0	C	33.5	C	32.4	C	36.4	D
			WBT	39.4	D	40.1	D	46.4	D	43.6	D
			WBTR	40.1	D	41.3	D	46.7	D	44.9	D
			NBL	20.8	C	15.3	B	29.2	C	23.8	C
			NBT	29.1	C	24.0	C	31.6	C	26.3	C
			NBR	24.1	C	20.6	C	24.2	C	21.3	C
			SBL	21.0	C	17.4	B	30.2	C	27.9	C
			SBT	26.6	C	23.1	C	30.3	C	25.9	C
			SBR	26.5	C	22.6	C	26.2	C	23.1	C
			Overall	**31.6**	**C**	**27.6**	**C**	**35.4**	**D**	**32.9**	**C**
5	Hampden Street	Signalized	EBTL	0.2	A	0.2	A	0.3	A	0.5	A
			EBTR	0.2	A	0.2	A	0.4	A	0.5	A
			WBTL	2.6	A	2.4	A	3.1	A	2.6	A
			WBTR	2.7	A	2.4	A	3.1	A	2.7	A
			NB	44.2	D	38.3	D	39.1	D	38.6	D
			SB	43.4	D	38.3	D	38.8	D	38.5	D
			Overall	**4.1**	**A**	**3.6**	**A**	**4.0**	**A**	**3.0**	**A**
6	NB Stephenson Highway	Signalized	EBL	18.5	B	3.7	A	15.6	B	7.2	A
			EBT	8.4	A	2.1	A	10.8	B	3.0	A
			WBT	13.2	B	8.2	A	11.6	B	12.0	B
			WBR	14.5	B	8.4	A	13.7	B	12.4	B
			NBL	36.3	D	37.7	D	35.9	D	34.9	C
			NBTL	38.8	D	36.9	D	34.7	C	33.8	C
			NBR	35.5	D	37.2	D	34.0	C	34.3	C
			Overall	**21.9**	**C**	**14.9**	**B**	**18.7**	**B**	**15.2**	**B**

4 ROAD DIET (3-LANES)

4.1 OPENING DAY ANALYSIS (2024)

The proposed road diet configuration (3-lanes) was evaluated along the 11 Mile Road corridor, based on the proposed lane use and traffic control shown on the attached **Figure 4**, existing (2024) peak hour traffic volumes shown on the attached **Figure 3**, and methodologies presented in the HCM. The road diet intersection operations analysis results are attached and summarized in the attached **Table 3**. The results of the road diet evaluation indicate that, with the implementation of the proposed three-lane road-diet, all study intersection approaches and movements will continue to operate in a manner similar to the existing conditions analysis, with additional impacts for LOS for the following location:

Dequindre Road & 11 Mile Road

- During the MD peak hour: The westbound right-turn lane is expected to operate at LOS E.
- Review of SimTraffic network simulations indicates the westbound right-turn movement operates acceptably during the MD peak hour, the majority of vehicle queues were observed to be serviced within each cycle length.

Review of SimTraffic network simulations indicates generally acceptable operations throughout the study roadway network. Vehicle queues were observed to be serviced within each cycle length with minimal residual vehicle queueing. However, the westbound through movement at the intersection of Dequindre Road & 11 Mile

Road was observed to experience periods of long vehicle queues during the School PM peak period. However, these queues were observed to dissipate throughout the School PM peak period.

A corridor travel time evaluation was completed utilizing SimTraffic network simulations to calculate the existing network travel time and the projected travel time with the proposed road diet. The results of this comparison show negligible change in travel time for the peak periods, with the highest increase occurring for the westbound traffic during the School PM peak which is anticipate to increase by approximately three (3) minutes. The travel time summary for each peak period is attached and summarized in **Table 4.**

Table 3: Road Diet Geometry (3-Lanes) Travel Time – Opening Day (2024)

Peak Period	Existing Conditions (2024)		Road Diet Opening Day (2024)		Difference	
	EB (minutes)	WB (minutes)	EB (minutes)	WB (minutes)	EB (minutes)	WB (minutes)
AM Peak	4.36	5.06	4.54	5.35	0.18	0.29
MD Peak	3.85	4.44	3.92	4.63	0.07	0.19
School PM Peak	4.64	5.16	4.74	8.19	0.10	3.04
PM Peak	4.39	5.13	4.47	5.59	0.08	0.46

4.2 Horizon Year Analysis (2044)

Historical population and economic profile data was obtained for the City of Madison Heights from the Southeast Michigan Council of Governments (SEMCOG) database, in order to calculate a background growth rate to project the existing 2024 peak hour traffic volumes to the horizon year of 2044. Population and employment projections from 2020 to 2050 were reviewed and show an average annual growth rate of 0.15% and 0.32%, respectively. Therefore, a conservative background growth rate of **0.5%** per year was applied to the existing peak hour traffic volumes to forecast the horizon year 2044 peak hour traffic volumes, as shown on the attached **Figure 5**.

The Horizon Year (2044) conditions analysis was evaluated based on the recommended lane use and traffic control shown on the attached **Figure 4**, peak hour traffic volumes shown on the attached **Figure 5**, and methodologies presented in the HCM. The Horizon Year (2024) intersection operations analysis results are attached and summarized in the attached **Table 5**. The results of the Horizon Year (2044) road diet evaluation indicate that all study intersection approaches and movements will continue to operate in a manner similar to the Opening Day (2024) conditions analysis, with following additional impacts to LOS:

Dequindre Road & 11 Mile Road

- During the AM peak hour: The southbound left-turn movement is expected to operate at LOS E.
- During the School PM peak hour: The northbound left-turn movement is expected to operate at LOS E.

  Review of SimTraffic network simulations indicate long periods of vehicle queues for the southbound left-turn and westbound through movements during the AM, School PM, and PM peak periods. These queues were observed to be present throughout the School PM peak hour. The 95th percentile queue length for the southbound left-turn and westbound through movements were observed to be the highest during the AM peak hour, at 880 feet, and the School PM peak hour, at 1,650 feet, respectively. This intersection is under the jurisdiction of Macomb County Department of Road (MCDR) and currently operates with a 180 second cycle length. Preliminary analysis indicates that queues would be reduced by optimizing the cycle length to 120 seconds.

John R Road & 11 Mile Road

- During the School PM peak hour: The northbound and southbound through movements are expected to operate at LOS F and the overall intersection is expected to operate at LOS E.

  Review of SimTraffic network simulations indicated periods of long vehicle queues during the School PM peak period for the northbound and southbound approaches. However, these queues were observed to dissipate and were not present throughout the entire peak hour.

A corridor travel time evaluation was completed utilizing SimTraffic network simulations to calculate the projected Opening Day (2024) network travel time and the projected Horizon Year (2044) travel time with the proposed road diet. The results of this comparison show negligible change in travel time for the peak periods, with the highest increase occurring for the westbound traffic during the School PM peak which is anticipate to increase by approximately four (4) minutes. The travel time summary for each peak period is attached and summarized in **Table 6.**

Table 4: Road Diet Geometry (3-Lanes) Travel Time – Horizon Year (2044)

Peak Period	Road Diet Opening Day (2024)		Road Diet Horizon Year (2044)		Difference	
	EB (minutes)	WB (minutes)	EB (minutes)	WB (minutes)	EB (minutes)	WB (minutes)
AM Peak	4.54	5.35	4.44	5.98	-0.10	0.63
MD Peak	3.92	4.63	3.95	4..73	0.04	0.10
School PM Peak	4.74	8.19	4.76	11.91	0.02	3.71
PM Peak	4.47	5.59	4.77	5.78	18.1	0.20

Note: Decreased travel times result from SCATS optimizations, improved progression, and HCM methodologies.

5 Safety Study

5.1 Crash Analysis

A crash analysis was conducted at the study intersections and roadway segments along the 11 Mile Road corridor. F&V obtained the crash data used in the analysis from the Michigan Traffic Crash Facts (MTCF) historical crash database for the most recent **five years** (January 1, 2018 to December 31, 2022) of available data. There were a total of 289 crashes reported along the study corridor in the past five years. There were 86 crashes with injuries, include four (4) “Type A” injury crashes; however, there were no fatalities.

The general crash type along the corridor is Angle (43%), Rear-End – Straight (27%), and Sideswipe – Same Direction (11%) crashes. The majority of crashes at the signalized intersections and angle and rear-end crashes, which is typical of signalized intersections. Review of the UD-10 reports for these intersections indicate that the crashes were distributed equally from all directions of travel, suggesting that a directional crash pattern was not present. All crashes included in this analysis are summarized in **Chart 1**. The individual intersection and segment crash types along the 11 Mile Road corridor are summarized in **Table 7**. Review of the summary data indicate that the majority of crashes occurred at the 11 Mile Road intersections with NB Stephenson Highway and Dequindre Road and along the roadway segments between Hampden Street and John R Road, John R Road and Lorenz Street, and Lorenz Street and Dequindre Road.

Chart 1: Percentage of Crashes by Type

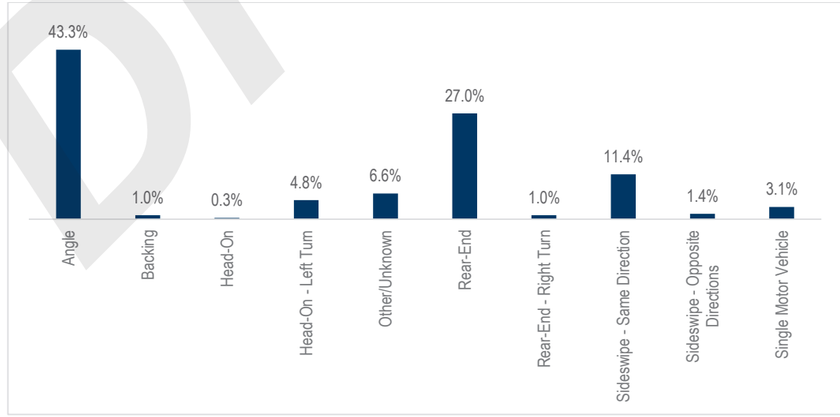


Table 5: Intersection and Segment Crash Summary by Crash Type

11 Mile Road – Road Location		Angle	Backing	Head-On	Head-On Left-Turn	Other/Unknown	Rear-End (Straight)	Rear-End Right-Turn	Sideswipe – Opposite	Sideswipe - Same	Single Motor Vehicle	Total	Percentage
NB Stephenson Hwy	Intersection	22	0	0	4	4	4	0	1	2	1	**38**	13%
NB Stephenson Hwy – Hampden Street	Segment	13	0	0	0	0	6	0	0	6	0	**25**	9%
Hampden Street	Intersection	1	0	0	0	1	1	0	0	0	0	**3**	1%
Hamden Street – John R Road	Segment	14	1	0	1	3	19	1	0	5	6	**50**	17%
John R Road	Intersection	13	0	0	1	3	4	0	1	4	0	**26**	9%
John R Road – Lorenz Street	Segment	17	0	1	1	3	16	1	0	6	0	**45**	16%
Lorenz Street	Intersection	7	0	0	0	1	1	0	0	0	0	**9**	3%
Lorenz Street – Hales Street	Segment	10	0	0	1	1	7	0	0	1	0	**20**	7%
Hales Street	Intersection	3	0	0	0	0	0	0	0	0	0	**3**	1%
Hales Street – Dequindre Road	Segment	9	1	0	1	1	13	0	1	7	2	**35**	12%
Dequindre Road	Intersection	16	1	0	5	2	7	1	1	2	0	**35**	12%
Total		**125**	**3**	**1**	**14**	**19**	**78**	**3**	**4**	**33**	**9**	**289**	**100%**

Table 6: Road Conditions Summary

Road Conditions		
Condition	**Number of Crashes**	**%**
Dry	217	75%
Other/Unknown	2	0%
Wet	53	18%
Snowy/Icy/Slush	17	6%
Total	**289**	**100%**

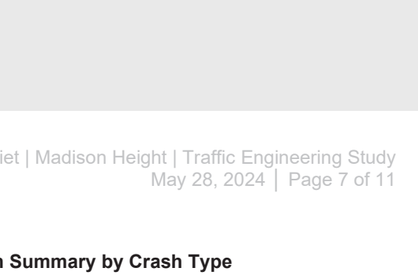


Table 7: Light Conditions Summary

Light Conditions		
Condition	**Number of Crashes**	**%**
Dark-Lighted	52	18%
Dark-Unlighted	1	0%
Dusk	4	1%
Dawn	3	1%
Daylight	229	79%
Total	**289**	**100%**

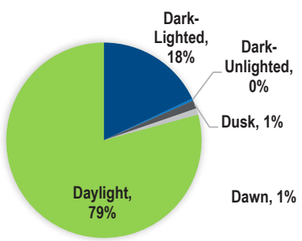
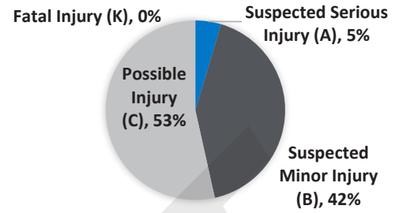


Table8: Crashes with Injury

Worst Injury in Crash		
Severity	**Crashes with Injury**	**% of Injuries**
Fatalities	0	0%
"A" Injuries	4	5%
"B" Injuries	36	42%
"C" Injuries	46	53%
Total	**86**	**100%**



The SEMCOG Crash Analysis Process *Regional Critical Intersection Crash Rates, Frequencies and Casualty Ratios: By Presence or Absence of Signalization* was used to compare the actual crash rates and frequencies to the regional rates for similar intersection operations. The study area included in this analysis is located within the SEMCOG region. Therefore, the data provided by SEMCOG provides an applicable comparison to the crash rates experienced within the study area. The results of the analysis are summarized in **Table 11**.

Table 9: Study Network Intersection Crash Comparison

	Intersection	Average ADT (Entering Volume vpd)	Total (5 years)	Crash Frequency (crashes/year)			Crash Rate (crashes per MV)		
				Intersection Annual Crash Frequency	SEMCOG Average Annual Crash Frequency	Difference	Intersection Crash Rate	SEMCOG Average Crash Rate	Difference
1	11 Mile Road & Dequindre Road	34,223	35	7.0	13.51	-6.51	0.56	1.07	-0.51
2	11 Mile Road & Hales Street	10,373	3	0.6	4.69	-4.09	0.16	0.87	-0.71
3	11 Mile Road & Lorenz Street	10,900	9	1.8	4.69	-2.89	0.45	0.87	-0.42
4	11 Mile Road & John R Road	23,607	26	5.2	8.77	-3.57	0.60	0.96	-0.36
5	11 Mile Road & Hampden Street	11,477	3	0.6	4.69	-4.09	0.14	0.87	-0.73
6	11 Mile Road & NB Stephenson Hwy	17,573	38	7.6	4.69	2.91	1.18	0.87	0.31

The results of the analysis indicates that the majority of the study intersections currently have crash frequencies (crashes per year) and crash rates (crashes per million entering vehicles) below the SEMCOG average for intersections with similar characteristics. The study intersection of 11 Mile Road and NB Stephenson Highway has crash frequency and crash rate above the SEMCOG average. Further review of the crash reports indicates that the majority of crashes at the 11 Mile Road & NB Stephenson Highway intersection were angle crashes (58%). However, NB Stephenson Highway is the project limits for this study; therefore, no changes to the roadway geometry or traffic control operations are recommended as part of this study. It should be noted that the intersection of NB Stephenson Highway and 11 Mile Road is under the jurisdiction of the City of Royal Oak; therefore, any further investigation into this intersection would be completed by the City of Royal Oak.

5.2 Highway Safety Manual Analysis

The Federal Highway Administration (FHWA) has identified Road Diets a proven safety countermeasure and promotes them as a safety-focused design alternative to a traditional four-lane. In order to determine the predictive impact on safety, an analysis was performed according to the Highway Safety Manual (HSM) crash predictive methodology. The analysis included the evaluation of the existing operations along the 11-Mile Road corridor and a safety review of the operations after the implementation of the recommended road diet to provide corridor-wide three-lane striping.

The latest HSM predictive methods analysis spreadsheet, provided by the MDOT Safety Programs Unit, was utilized to determine the expected and predicted crashes associated with the existing conditions and proposed road diet conditions. This analysis used the urban/sub-urban segments model and the crash prediction values

provided by MDOT in the HSM spreadsheet. The results of the analysis are summarized in **Table 12** below and the detailed HSM summary sheets are attached.

Table 12: Highway Safety Analysis Summary

Scenario	Property Damage Only (PDO)		Fatal and Injury (FI)		Total			
	Predicted Crashes per Year	Crash Rate (Crashes / mile / year)	Predicted Crashes per Year	Crash Rate (Crashes / mile / year)	Predicted Crashes per Year	Reduction (%)	Crash Rate (Crashes / mile / year)	Reduction (%)
NB Stephenson Hwy to Hamden St	0.46	4.64	0.10	0.95	0.56		5.59	
Road Diet (4-lane to 3-lane)	0.41	4.11	0.06	0.64	0.47	**15.1%**	4.74	**15.1%**
Hampden St to John R Rd	2.07	4.94	0.43	1.02	2.50		5.96	
Road Diet (4-lane to 3-lane)	1.83	4.35	0.29	0.68	2.12	**15.5%**	5.04	**15.5%**
John R Rd to Lorenz St	1.14	4.06	0.23	.084	1.37		4.89	
Road Diet (4-lane to 3-lane)	1.00	3.58	0.16	0.56	1.16	**15.4%**	4.14	**15.4%**
Lorenz St to Hales St	0.96	2.66	0.22	0.60	1.18		3.27	
Road Diet (4-lane to 3-lane)	0.85	2.36	0.15	0.40	0.99	**15.5%**	2.76	**15.5%**
Hales St to Dequindre Rd	1.90	5.01	0.42	1.10	2.32		6.11	
Road Diet (4-lane to 3-lane)	1.68	4.41	0.28	0.74	1.96	**15.7%**	5.15	**15.7%**

The result of the analysis indicates that the 4-lane to 3-lane road diet is expected to reduce the predicted crash rates and frequencies by approximately 15-16% per year throughout the 11-Mile Road study corridor.

6 Conclusions

The conclusions of this Traffic Study are as follows:

1. Existing Conditions Analysis (4-Lanes)

- The results of the existing conditions analysis indicates that all approaches and movements at the study intersections are currently operating acceptably, at LOS D or better, during the AM, MD, School PM, and PM peak periods with the following exceptions:
  - **Dequindre Road & 11 Mile Road**
    - Several intersection approaches and movements currently operate at LOS E or F during the peak periods.
    - Review of the operations show that the signal currently operates with a 180 second cycle length. Therefore, it is not unreasonable for vehicles to experience high delays. Review of SimTraffic network simulations indicates that the majority of vehicle queues were observed to be serviced within each cycle length throughout the study corridor.

2. Road Diet Analysis (3-Lanes)

Opening Day (2024)

- The results of the road diet evaluation indicate that, with the implementation of the proposed three-lane road-diet, all study intersection approaches and movements will continue to operate in a manner similar to the existing conditions analysis, with the exception of the following:
  - **Dequindre Road & 11 Mile Road**
    - During the MD peak hour: The westbound right-turn lane is expected to operate at LOS E.
- Review of SimTraffic network simulations indicates the westbound right-turn movement operates acceptably during the MD peak hour, the majority of vehicle queues were observed to be serviced within each cycle length.

- A corridor travel time evaluation was completed utilizing SimTraffic network simulations to calculate the existing network travel time and the projected travel time with the proposed road diet. The results of this comparison show negligible change in travel time for the peak periods, with the highest increase occurring for the westbound traffic during the School PM peak which is anticipated to increase by approximately three (3) minutes.

Horizon Year (2044)

- The results of the Horizon Year (2044) road diet evaluation indicates that all study intersection approaches and movements will continue to operate in a manner similar to the Opening Day (2024) conditions analysis, with the exception of the following:
  - **Dequindre Road & 11 Mile Road**
    - During the AM peak hour: The southbound left-turn movement is expected to operate at LOS E.
    - During the School PM peak hour: The northbound left-turn movement is expected to operate at LOS E.
    - Review of SimTraffic network simulations indicates long periods of vehicle queues for the southbound left-turn and westbound through movements during the AM, School PM, and PM peak periods. These queues were observed to be present throughout the School PM peak hour. The 95th percentile queue length for the southbound left-turn and westbound through movemetns were observed to be highest during the AM peak hour, at 880 feet, and the School PM peak hour, at 1,650 feet, respectively. This intersection is under the jurisdiction of MCDR and currently operates with a 180 second cycle length. Preliminary analysis indicates that queues would be reduced by optimizing the cycle length to 120 seconds.
  - **John R Road & 11 Mile Road**
    - During the School PM peak hour: The northbound and southbound through movements are expected to operate at LOS F and the overall intersection is expected to operate at LOS E.
    - Review of SimTraffic network simulations indicated periods of long vehicle queues during the School PM peak period for the northbound and southbound approaches. However, these queues were observed to dissipate and were not present throughout the entire peak hour.
- A corridor travel time evaluation was completed utilizing SimTraffic network simulations to calculate the projected Opening Day (2024) network travel time and the projected Horizon Year (2044) travel time with the proposed road diet. The results of this comparison show negligible change in travel time for the peak periods, with the highest increase occurring for the westbound traffic during the School PM peak which is anticipated to increase by approximately four (4) minutes.

3. Safety Analysis

- The result of the crash analysis indicates that there were a total of 289 crashes reported along the 11 Mile Road corridor in the past five year (2018-2022); of these crashes, 86 involved injuries, including four (4) “Type A” injuries. The general crash type trends were Angle (43%), Rear-End – Straight (27%), and Sideswipe – Same Direction (11%) crashes.
- The analysis indicates that the majority of the study intersections have crash frequencies and crash rates below the SEMCOG average for comparable intersections. The study intersection of 11 Mile Road & NB Stephenson Highway has crash frequency and crash rate above the SEMCOG average. It should be noted that the intersection of NB Stephenson Highway & 11 Mile Road is under the jurisdiction of the City of Royal Oak; therefore, any further investigation into this intersection would be completed by the City of Royal Oak.
- A safety review was performed according to the Highway Safety Manual (HSM) crash predictive methodology. The result of the analysis indicates that 4-lane to 3-lane road diet would reduce the

predicted crash rates and frequencies by approximately 15-16% per year throughout the 11 Mile Road study corridor.

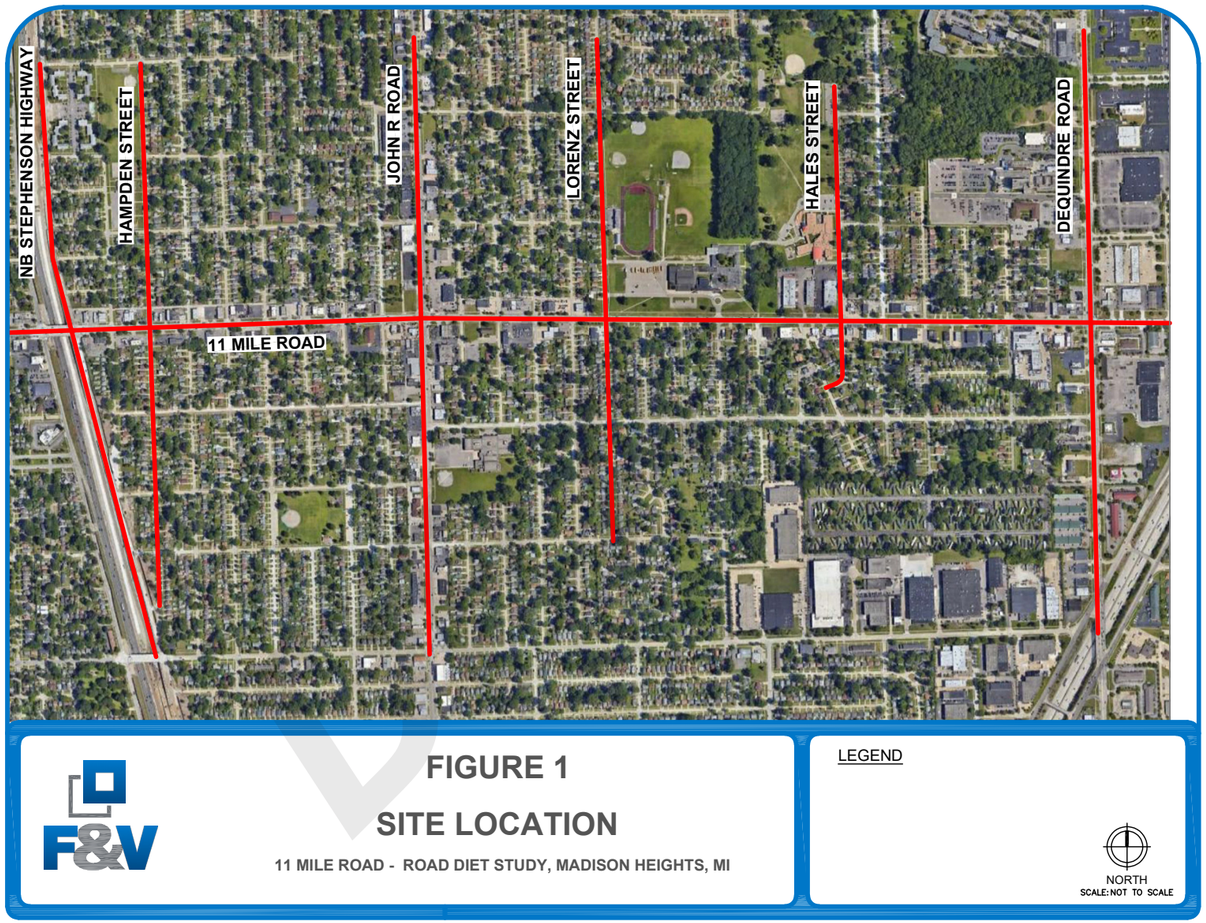
7 RECOMMENDATIONS

- The primary goal of this road diet is to improve safety and reduce the crashes along the 11 Mile Road corridor. The result of the analysis indicates that crashes are expected to be reduced by **15-16%.**
- It is recommended that the road diet is implemented. There are several options to consider for the extra space created by the eliminated lanes, such as parking space, bike lanes, additional green space, etc. The use of the additional space is up to the discretion of the city.
- It is recommended that at the intersection of Dequindre Road & 11 Mile Road, that the westbound approach be restriped to include a left-turn lane, a through lane, and a right-turn lane.
- It is recommended that at the intersection of John R Road & 11 Mile Road, that the eastbound and westbound approaches be restriped to include a left-turn lane, a through lane, and a right-turn lane.

Any questions related to this memorandum, study, analysis, and results should be addressed to Fleis & VandenBrink.

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Michigan.

Attached:
Figures 1-5
Traffic Volume Data
HCM LOS Description
Synchro Results
Table 3
Table 5
HSM Crash Analysis



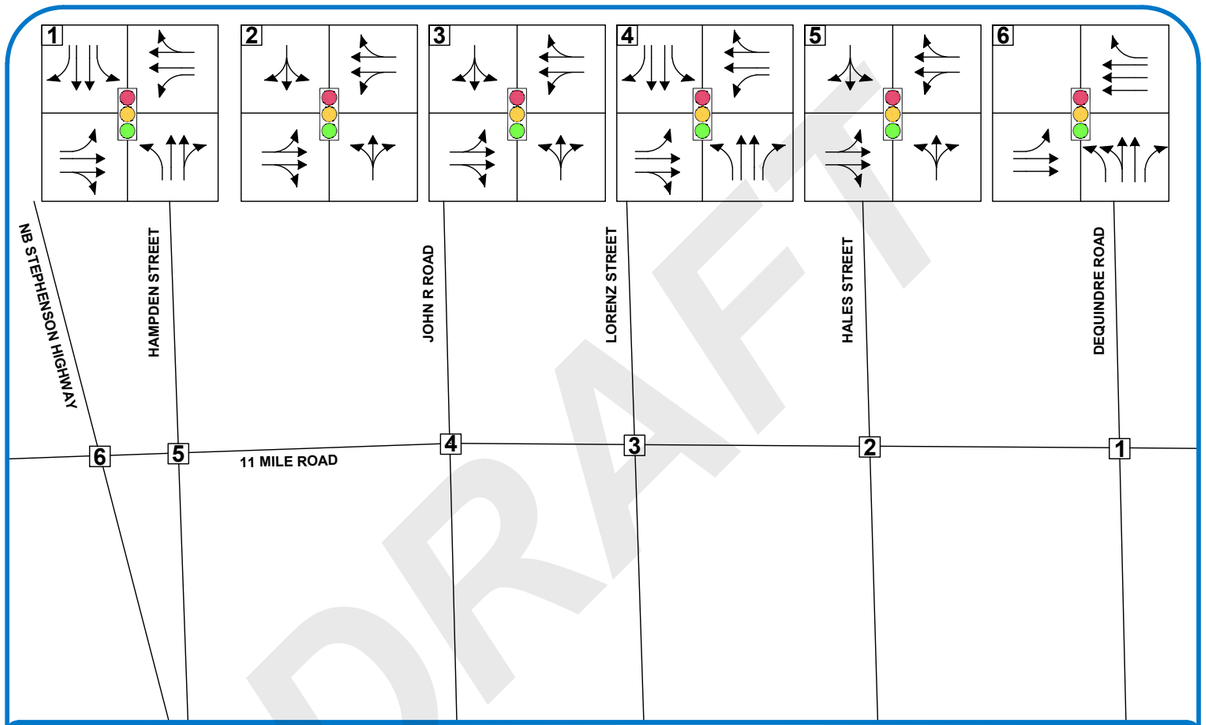


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FIGURE 2
EXISTING LANE USE AND TRAFFIC CONTROL

11 MILE ROAD - ROAD DIET STUDY, MADISON HEIGHTS, MI

LEGEND
ROADS
LANE USE
SIGNALIZED INTERSECTION

NORTH
SCALE: NOT TO SCALE

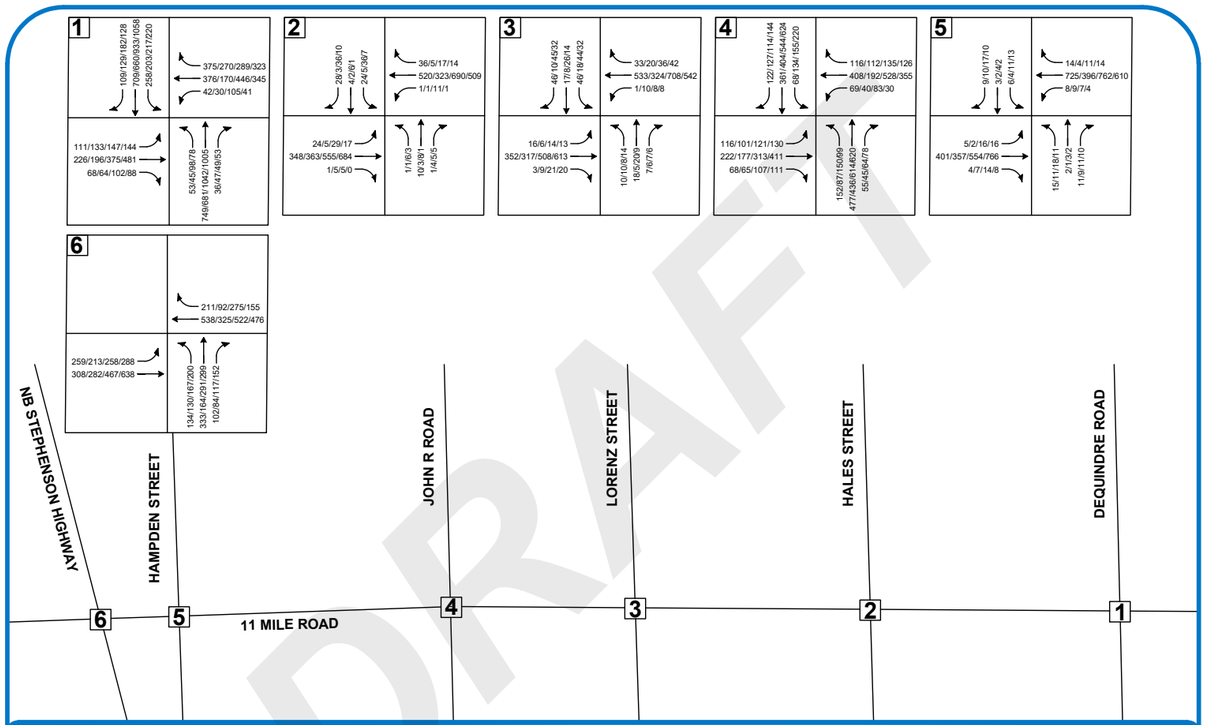

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FIGURE 3
EXISTING TRAFFIC VOLUMES

11 MILE ROAD - ROAD DIET STUDY, MADISON HEIGHTS, MI

LEGEND
ROADS
TRAFFIC VOLUMES (AM/MD/School PM/PM)

NORTH
SCALE: NOT TO SCALE

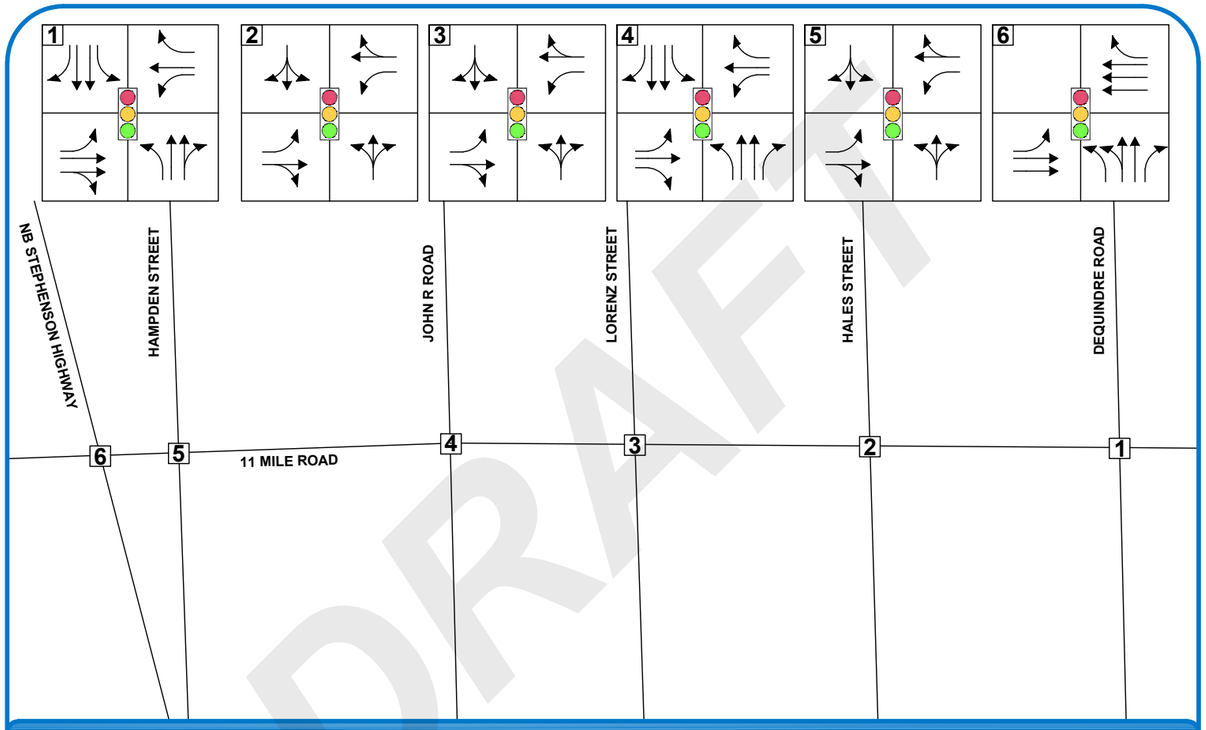

FIGURE 4
ROAD DIET LANE USE W/ RECOMMENDATIONS

11 MILE ROAD - ROAD DIET STUDY, MADISON HEIGHTS, MI

LEGEND
- ROADS
- ROAD DIET LANE USE
- SIGNALIZED INTERSECTION

NORTH
SCALE:NOT TO SCALE

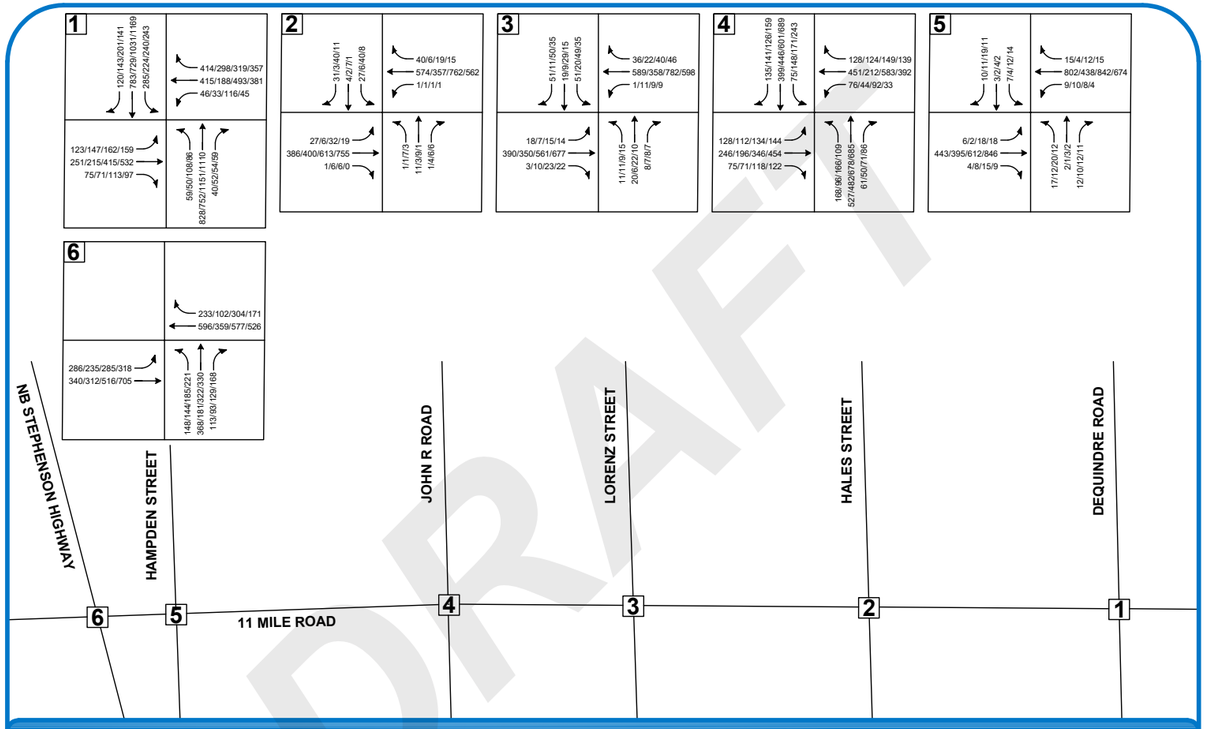

FIGURE 5
HORIZON YEAR (2044) TRAFFIC VOLUMES

11 MILE ROAD - ROAD DIET STUDY, MADISON HEIGHTS, MI

LEGEND
- ROADS
- TRAFFIC VOLUMES (AM/MD/School PM/PM)

NORTH
SCALE:NOT TO SCALE

Table 3: Road Diet Geometry (3 Lanes) Intersection Operations - Opening Day

	Intersection	Control	Approach	Existing Conditions (2024)								Road Diet (Opening Day 2024)								Difference							
				AM Peak		MD Peak		School PM Peak		PM Peak		AM Peak		MD Peak		School PM Peak		PM Peak		AM Peak		MD Peak		School PM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Dequindre Road & 11 Mile Road	Signalized	EBL	136.4	F	69.7	E	151.2	F	133.0	F	136.4	F	63.9	E	151.2	F	119.7	F	0.0	-	-5.8	-	0.0	-	-13.3	-
			EBTR	87.0	F	47.9	D	84.4	F	85.2	F	87.0	F	47.9	D	84.4	F	85.2	F	0.0	-	0.0	-	0.0	-	0.0	-
			WBL	59.7	E	35.9	D	68.1	E	72.0	E	59.7	E	37.6	D	67.6	E	72.5	E	0.0	-	1.7	-	-0.5	-	0.5	-
			WBT	85.4	F	36.2	D	97.5	F	81.9	F	78.3	E	36.1	D	120.4	F	77.3	E	-7.1	F→E	-0.1	-	22.9	-	-4.6	F→E
			WBTR / WBR	112.3	F	55.0	D	100.2	F	93.3	F	112.3	F	56.6	E	74.9	E	94.9	F	0.0	-	1.6	D→E	-25.3	F→E	1.6	-
			NBL	42.3	D	25.8	C	50.5	D	51.9	D	42.3	D	24.3	C	50.9	D	51.5	D	0.0	-	-1.5	-	0.4	-	-0.4	-
			NBTR	81.1	F	48.5	D	71.6	E	71.5	E	81.1	F	48.5	D	71.6	E	71.5	E	0.0	-	0.0	-	0.0	-	0.0	-
			SBL	49.5	D	29.9	C	62.7	E	57.9	E	49.5	D	28.3	C	63.2	E	57.4	E	0.0	-	-1.6	-	0.5	-	-0.5	-
			SBT	71.5	E	41.6	D	66.7	E	62.9	E	71.5	E	41.6	D	66.7	E	62.9	E	0.0	-	0.0	-	0.0	-	0.0	-
			SBR	46.2	D	27.6	C	41.0	D	34.6	C	46.2	D	29.1	C	41.0	D	34.7	C	0.0	-	1.5	-	0.0	-	0.1	-
			Overall	**80.0**	**E**	**44.6**	**D**	**77.5**	**E**	**73.6**	**E**	**79.2**	**E**	**44.4**	**D**	**78.3**	**E**	**72.8**	**E**	**-0.8**	**-**	**-0.2**	**-**	**0.8**	**-**	**-0.8**	**-**
2	Hales Street & 11 Mile Road	Signalized	EBTL / EBL	0.3	A	1.4	A	12.2	B	2.0	A	1.0	A	0.1	A	8.6	A	0.3	A	0.7	-	-1.3	-	-3.6	B→A	-1.7	-
			EBTR	0.3	A	1.5	A	12.7	B	2.1	A	0.5	A	0.4	A	4.7	A	1.0	A	0.2	-	-1.1	-	-8.0	B→A	-1.1	-
			WBTL / WBL	3.0	A	1.4	A	3.8	A	1.7	A	2.1	A	1.1	A	5.6	A	1.3	A	-0.9	-	-0.3	-	1.8	-	-0.4	-
			WBTR	3.0	A	1.4	A	3.9	A	1.8	A	4.3	A	1.7	A	6.1	A	2.3	A	1.3	-	0.3	-	2.2	-	0.5	-
			NB	33.5	C	38.4	D	32.3	C	37.6	D	33.5	C	38.4	D	32.4	C	37.6	D	0.0	-	0.0	-	0.1	-	0.0	-
			SB	36.8	D	38.4	D	36.4	D	38.6	D	36.9	D	38.4	D	36.8	D	38.6	D	0.1	-	0.0	-	0.4	-	0.0	-
			Overall	**5.2**	**A**	**2.8**	**A**	**10.3**	**B**	**3.1**	**A**	**6.0**	**A**	**2.4**	**A**	**8.5**	**A**	**2.8**	**A**	**0.8**	**-**	**-0.4**	**-**	**-1.8**	**B→A**	**-0.3**	**-**
3	Lorenz Street & 11 Mile Road	Signalized	EBTL / EBL	0.2	A	0.2	A	0.4	A	0.4	A	2.9	A	0.0	A	1.0	A	0.1	A	2.7	-	-0.2	-	0.6	-	-0.3	-
			EBTR	0.3	A	0.2	A	0.4	A	0.5	A	0.5	A	0.4	A	0.9	A	1.1	A	0.2	-	0.2	-	0.5	-	0.6	-
			WBTL / WBL	12.9	B	0.2	A	0.6	A	0.4	A	5.5	A	0.0	A	0.0	A	0.0	A	-7.4	B→A	-0.2	-	-0.6	-	-0.4	-
			WBTR	13.0	B	0.2	A	0.7	A	0.5	A	11.0	B	0.4	A	2.0	A	1.1	A	-2.0	-	0.2	-	1.3	-	0.6	-
			NB	31.2	C	37.1	D	31.9	C	35.1	D	31.4	C	37.1	D	32.1	C	35.1	D	0.2	-	0.0	-	0.2	-	0.0	-
			SB	35.6	D	38.6	D	36.1	D	37.5	D	35.9	D	38.6	D	36.5	D	37.7	D	0.3	-	0.0	-	0.4	-	0.2	-
			Overall	**12.4**	**B**	**3.6**	**A**	**4.3**	**A**	**3.6**	**A**	**11.5**	**B**	**3.8**	**A**	**5.3**	**A**	**4.2**	**A**	**-0.9**	**-**	**0.2**	**-**	**1.0**	**-**	**0.6**	**-**
4	John R Road & 11 Mile Road	Signalized	EBL	38.6	D	36.1	D	42.6	D	37.3	D	39.8	D	36.5	D	44.4	D	33.5	C	1.2	-	0.4	-	1.8	-	-3.8	D→C
			EBT	36.6	D	34.8	C	34.1	C	43.0	D	36.4	D	38.3	D	33.5	C	43.9	D	-0.2	-	3.5	C→D	-0.6	-	0.9	-
			EBTR / EBR	37.3	D	35.2	D	34.7	C	44.1	D	30.3	C	32.8	C	26.3	C	22.9	C	-7.0	D→C	-2.4	D→C	-8.4	-	-21.2	D→C
			WBL	33.0	C	33.5	C	32.4	C	36.4	D	31.4	C	34.7	C	30.0	C	37.1	D	-1.6	-	1.2	-	-2.4	-	0.7	-
			WBT	39.4	D	40.1	D	46.4	D	43.6	D	43.0	D	40.7	D	54.8	D	43.5	D	3.6	-	0.6	-	8.4	-	-0.1	-
			WBTR / WBR	40.1	D	41.3	D	46.7	D	44.9	D	29.8	C	37.1	D	26.0	C	31.2	C	-10.3	D→C	-4.2	-	-20.7	D→C	-13.7	D→C
			NBL	20.8	C	15.3	B	29.2	C	23.8	C	25.3	C	15.8	B	38.6	D	29.8	C	4.5	-	0.5	-	9.4	C→D	6.0	-
			NBT	29.1	C	24.0	C	31.6	C	26.3	C	32.2	C	23.0	C	39.5	D	30.5	C	3.1	-	-1.0	-	7.9	C→D	4.2	-
			NBR	24.1	C	20.6	C	24.2	C	21.3	C	25.9	C	19.9	B	27.0	C	23.9	C	1.8	-	-0.7	C→B	2.8	-	2.6	-
			SBL	21.0	C	17.4	B	30.2	C	27.9	C	25.3	C	18.0	B	43.6	D	36.0	D	4.3	-	0.6	-	13.4	C→D	8.1	C→D
			SBT	26.6	C	23.1	C	30.3	C	25.9	C	28.8	C	22.2	C	36.4	D	29.9	C	2.2	-	-0.9	-	6.1	C→D	4.0	-
			SBR	26.5	C	22.6	C	26.2	C	23.1	C	28.8	C	21.7	C	29.6	C	26.2	C	2.3	-	-0.9	-	3.4	-	3.1	-
			Overall	**31.6**	**C**	**27.6**	**C**	**35.4**	**D**	**32.9**	**C**	**33.1**	**C**	**27.2**	**C**	**39.6**	**D**	**33.9**	**C**	**1.5**	**-**	**-0.4**	**-**	**4.2**	**-**	**1.0**	**-**
5	Hampden Street & 11 Mile Road	Signalized	EBTL / EBL	0.2	A	0.2	A	0.3	A	0.5	A	1.1	A	0.2	A	2.3	A	0.7	A	0.9	-	0.0	-	2.0	-	0.2	-
			EBTR	0.2	A	0.2	A	0.4	A	0.5	A	0.5	A	0.4	A	0.8	A	1.4	A	0.3	-	0.2	-	0.4	-	0.9	-
			WBTL / WBL	2.6	A	2.4	A	3.1	A	2.6	A	1.8	A	1.9	A	2.0	A	1.9	A	-0.8	-	-0.5	-	-1.1	-	-0.7	-
			WBTR	2.7	A	2.4	A	3.1	A	2.7	A	4.1	A	3.0	A	5.4	A	3.7	A	1.4	-	0.6	-	2.3	-	1.0	-
			NB	44.2	D	38.3	D	39.1	D	38.6	D	44.2	D	38.3	D	39.2	D	38.6	D	0.0	-	0.0	-	0.1	-	0.0	-
			SB	43.4	D	38.3	D	38.8	D	38.5	D	43.4	D	38.3	D	38.8	D	38.5	D	0.0	-	0.0	-	0.0	-	0.0	-
			Overall	**4.1**	**A**	**3.6**	**A**	**4.0**	**A**	**3.0**	**A**	**5.0**	**A**	**4.0**	**A**	**5.5**	**A**	**3.9**	**A**	**0.9**	**-**	**0.4**	**-**	**1.5**	**-**	**0.9**	**-**
6	NB Stephenson Highway & 11 Mile Road	Signalized	EBL	18.5	B	3.7	A	15.6	B	7.2	A	18.5	B	3.7	A	15.6	B	7.2	A	0.0	-	0.0	-	0.0	-	0.0	-
			EBT	8.4	A	2.1	A	10.8	B	3.0	A	8.4	A	2.1	A	10.8	B	3.0	A	0.0	-	0.0	-	0.0	-	0.0	-
			WBT	13.2	B	8.2	A	11.6	B	12.0	B	12.9	B	8.4	A	12.4	B	12.5	B	-0.3	-	0.2	-	0.8	-	0.5	-
			WBR	14.5	B	8.4	A	13.7	B	12.4	B	13.8	B	8.5	A	14.0	B	12.7	B	-0.7	-	0.1	-	0.3	-	0.3	-
			NBL	36.3	D	37.7	D	35.9	D	34.9	C	36.3	D	37.7	D	35.9	D	34.9	C	0.0	-	0.0	-	0.0	-	0.0	-
			NBTL	38.8	D	36.9	D	34.7	C	33.8	C	38.8	D	36.9	D	34.7	C	33.8	C	0.0	-	0.0	-	0.0	-	0.0	-
			NBR	35.5	D	37.2	D	34.0	C	34.3	C	35.5	D	37.2	D	34.0	C	34.3	C	0.0	-	0.0	-	0.0	-	0.0	-
			Overall	**21.9**	**C**	**14.9**	**B**	**18.7**	**B**	**15.2**	**B**	**21.7**	**C**	**15.0**	**A**	**19.0**	**B**	**15.3**	**B**	**-0.2**	**-**	**0.1**	**B→A**	**0.3**	**-**	**0.1**	**-**

** Decreased delays and improved LOS are the result of improved progression and arrival on green factors and HCM methodology*

Table 5: Road Diet Geometry (3 Lanes) Intersection Operations - Horizon Year (2044)

	Intersection	Control	Approach	Road Diet (Opening Day 2024)								Road Diet (Horizon Year 2044)								Difference							
				AM Peak		MD Peak		School PM Peak		PM Peak		AM Peak		MD Peak		School PM Peak		PM Peak		AM Peak		MD Peak		School PM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Dequindre Road & 11 Mile Road	Signalized	EBL	136.4	F	63.9	E	151.2	F	119.7	F	166.0	F	66.7	E	179.9	F	146.5	F	29.6	-	2.8	-	28.7	-	26.8	-
			EBTR	87.0	F	47.9	D	84.4	F	85.2	F	85.7	F	47.3	D	85.4	F	86.6	F	-1.3	-	-0.6	-	1.0	-	1.4	-
			WBL	59.7	E	37.6	D	67.6	E	72.5	E	61.3	E	36.3	D	70.8	E	72.3	E	1.6	-	-1.3	-	3.2	-	-0.2	-
			WBT	78.3	E	36.1	D	120.4	F	77.3	E	92.8	F	35.0	D	157.6	F	78.7	E	14.5	E→F	-1.1	-	37.2	-	1.4	-
			WBTR / WBR	112.3	F	56.6	E	74.9	E	94.9	F	143.0	F	59.9	E	85.5	F	100.4	F	30.7	-	3.3	-	10.6	E→F	5.5	-
			NBL	42.3	D	24.3	C	50.9	D	51.5	D	45.8	D	27.9	C	55.4	E	59.1	E	3.5	-	3.6	-	4.5	D→E	7.6	D→E
			NBTR	81.1	F	48.5	D	71.6	E	71.5	E	77.5	E	47.1	D	68.6	E	68.5	E	-3.6	F→E	-1.4	-	-3.0	-	-3.0	-
			SBL	49.5	D	28.3	C	63.2	E	57.4	E	55.9	E	32.8	C	73.8	E	69.5	E	6.4	D→E	4.5	-	10.6	-	12.1	-
			SBT	71.5	E	41.6	D	66.7	E	62.9	E	68.2	E	40.3	D	63.2	E	59.4	E	-3.3	-	-1.3	-	-3.5	-	-3.5	-
			SBR	46.2	D	29.1	C	41.0	D	34.7	C	42.9	D	27.0	C	37.6	D	31.1	C	-3.3	-	-2.1	-	-3.4	-	-3.6	-
			Overall	79.2	E	44.4	D	78.3	E	72.8	E	**84.1**	**F**	**44.4**	**D**	**83.5**	**F**	**73.5**	**E**	**4.9**	**E→F**	**0.0**	**-**	**5.2**	**E→F**	**0.7**	**-**
2	Hales Street & 11 Mile Road	Signalized	EBTL / EBL	1.0	A	0.1	A	8.6	A	0.3	A	1.4	A	0.1	A	4.5	A	0.4	A	0.4	-	0.0	-	-4.1	-	0.1	-
			EBTR	0.5	A	0.4	A	4.7	A	1.0	A	0.5	A	0.4	A	1.4	A	1.3	A	0.0	-	0.0	-	-3.3	-	0.3	-
			WBTL / WBL	2.1	A	1.1	A	5.6	A	1.3	A	2.2	A	1.2	A	3.0	A	1.3	A	0.1	-	0.1	-	-2.6	-	0.0	-
			WBTR	4.3	A	1.7	A	6.1	A	2.3	A	4.8	A	1.8	A	7.6	A	2.6	A	0.5	-	0.1	-	1.5	-	0.3	-
			NB	33.5	C	38.4	D	32.4	C	37.6	D	33.4	C	38.3	D	31.7	C	37.5	D	-0.1	-	-0.1	-	-0.7	-	-0.1	-
			SB	36.9	D	38.4	D	36.8	D	38.6	D	37.3	D	38.4	D	36.3	D	38.5	D	0.4	-	0.0	-	-0.5	-	-0.1	-
			Overall	6.0	A	2.4	A	8.5	A	2.8	A	**6.2**	**A**	**2.4**	**A**	**7.9**	**A**	**2.9**	**A**	**0.2**	**-**	**0.0**	**-**	**-0.6**	**-**	**0.1**	**-**
3	Lorenz Street & 11 Mile Road	Signalized	EBTL / EBL	2.9	A	0.0	A	1.0	A	0.1	A	3.9	A	0.0	A	0.1	A	0.1	A	1.0	-	0.0	-	-0.9	-	0.0	-
			EBTR	0.5	A	0.4	A	0.9	A	1.1	A	0.6	A	4.0	A	1.1	A	1.4	A	0.1	-	3.6	-	0.2	-	0.3	-
			WBTL / WBL	5.5	A	0.0	A	0.0	A	0.0	A	5.8	A	0.0	A	0.0	A	0.1	A	0.3	-	0.0	-	0.0	-	0.1	-
			WBTR	11.0	B	0.4	A	2.0	A	1.1	A	12.4	A	0.4	A	2.8	A	1.4	A	1.4	B→A	0.0	-	0.8	-	0.3	-
			NB	31.4	C	37.1	D	32.1	C	35.1	D	30.7	C	37.0	D	31.3	C	34.9	C	-0.7	-	-0.1	-	-0.8	-	-0.2	D→C
			SB	35.9	D	38.6	D	36.5	D	37.7	D	35.5	D	38.7	D	36.1	D	37.4	D	-0.4	-	0.1	-	-0.4	-	-0.3	-
			Overall	11.5	B	3.8	A	5.3	A	4.2	A	**12.2**	**B**	**3.9**	**A**	**5.8**	**A**	**4.4**	**A**	**0.7**	**-**	**0.1**	**-**	**0.5**	**-**	**0.2**	**-**
4	John R Road & 11 Mile Road	Signalized	EBL	39.8	D	36.5	D	44.4	D	33.5	C	42.7	D	37.0	D	50.5	D	34.9	C	2.9	-	0.5	-	6.1	-	1.4	-
			EBT	36.4	D	38.3	D	33.5	C	43.9	D	35.8	D	37.9	D	32.3	C	49.3	D	-0.6	-	-0.4	-	-1.2	-	5.4	-
			EBTR / EBR	30.3	C	32.8	C	26.3	C	22.9	C	29.4	C	32.1	C	25.0	C	21.9	C	-0.9	-	-0.7	-	-1.3	-	-1.0	-
			WBL	31.4	C	34.7	C	30.0	C	37.1	D	31.1	C	34.7	C	27.1	C	37.1	D	-0.3	-	0.0	-	-2.9	-	0.0	-
			WBT	43.0	D	40.7	D	54.8	D	43.5	D	45.1	D	40.7	D	48.8	D	45.7	D	2.1	-	0.0	-	-6.0	-	2.2	-
			WBTR / WBR	29.8	C	37.1	D	26.0	C	31.2	C	29.0	C	36.7	D	20.5	C	30.6	C	-0.8	-	-0.4	-	-5.5	-	-0.6	-
			NBL	25.3	C	15.8	B	38.6	D	29.8	C	28.3	C	17.5	B	46.4	D	32.0	C	3.0	-	1.7	-	7.8	-	2.2	-
			NBT	32.2	C	23.0	C	39.5	D	30.5	C	30.5	C	24.7	C	134.6	F	38.6	D	-1.7	-	1.7	-	95.1	D→F	8.1	C→D
			NBR	25.9	C	19.9	B	27.0	C	23.9	C	24.3	C	20.7	C	31.8	C	26.0	C	-1.6	-	0.8	B→C	4.8	-	2.1	-
			SBL	25.3	C	18.0	B	43.6	D	36.0	D	28.1	C	20.3	C	52.3	D	46.7	D	2.8	-	2.3	B→C	8.7	-	10.7	-
			SBT	28.8	C	22.2	C	36.4	D	29.9	C	27.2	C	23.6	C	100.9	F	36.8	D	-1.6	-	1.4	-	64.5	D→F	6.9	C→D
			SBR	28.8	C	21.7	C	29.6	C	26.2	C	27.1	C	23.0	C	37.6	D	29.4	C	-1.7	-	1.3	-	8.0	C→D	3.2	-
			Overall	33.1	C	27.2	C	39.6	D	33.9	C	**33.0**	**C**	**28.2**	**C**	**69.6**	**E**	**39.1**	**D**	**-0.1**	**-**	**1.0**	**-**	**30.0**	**D→E**	**5.2**	**C→D**
5	Hampden Street & 11 Mile Road	Signalized	EBTL / EBL	1.1	A	0.2	A	2.3	A	0.7	A	1.6	A	0.3	A	3.5	A	0.9	A	0.5	-	0.1	-	1.2	-	0.2	-
			EBTR	0.5	A	0.4	A	0.8	A	1.4	A	0.5	A	0.4	A	1.0	A	1.7	A	0.0	-	0.0	-	0.2	-	0.3	-
			WBTL / WBL	1.8	A	1.9	A	2.0	A	1.9	A	1.8	A	2.0	A	2.0	A	1.9	A	0.0	-	0.1	-	0.0	-	0.0	-
			WBTR	4.1	A	3.0	A	5.4	A	3.7	A	4.6	A	3.1	A	6.3	A	4.0	A	0.5	-	0.1	-	0.9	-	0.3	-
			NB	44.2	D	38.3	D	39.2	D	38.6	D	44.4	D	38.3	D	39.3	D	38.7	D	0.2	-	0.0	-	0.1	-	0.1	-
			SB	43.4	D	38.3	D	38.8	D	38.5	D	43.6	D	38.3	D	39.0	D	38.5	D	0.2	-	0.0	-	0.2	-	0.0	-
			Overall	5.0	A	4.0	A	5.5	A	3.9	A	**5.4**	**A**	**4.0**	**A**	**6.1**	**A**	**4.2**	**A**	**0.4**	**-**	**0.0**	**-**	**0.6**	**-**	**0.3**	**-**
6	NB Stephenson Highway & 11 Mile Road	Signalized	EBL	18.5	B	3.7	A	15.6	B	7.2	A	23.5	C	4.2	A	19.3	B	9.2	A	5.0	B→C	0.5	-	3.7	-	2.0	-
			EBT	8.4	A	2.1	A	10.8	B	3.0	A	10.2	B	2.1	A	12.2	B	3.2	A	1.8	A→B	0.0	-	1.4	-	0.2	-
			WBT	12.9	B	8.4	A	12.5	B	8.9	A	14.1	B	8.9	A	13.9	B	13.1	B	1.2	-	0.5	-	1.5	-	0.6	-
			WBR	13.8	B	8.5	A	14.0	B	12.7	B	15.2	B	8.9	A	16.1	B	13.5	B	1.4	-	0.4	-	2.1	-	0.8	-
			NBL	36.3	D	37.7	D	35.9	D	34.9	C	34.8	C	37.7	D	34.9	C	34.5	C	-1.5	D→C	0.0	-	-1.0	D→C	-0.4	-
			NBTL	38.8	D	36.9	D	34.7	C	33.8	C	37.4	D	36.7	D	33.6	C	33.3	C	-1.4	-	-0.2	-	-1.1	-	-0.5	-
			NBR	35.5	D	37.2	D	34.0	C	34.3	C	34.0	C	37.0	D	32.8	C	34.0	C	-1.5	D→C	-0.2	-	-1.2	-	-0.3	-
			Overall	21.7	C	15.0	A	19.0	B	15.3	B	**22.5**	**C**	**15.2**	**B**	**20.0**	**C**	**15.8**	**B**	**0.8**	**-**	**0.2**	**A→B**	**1.0**	**B→C**	**0.5**	**-**

** Decreased delays and improved LOS are the result of improved progression and arrival on green factors and HCM methodology*