



Client: City of Ann Arbor  
Project Name: East Stadium Boulevard Bridge Replacement Project  
Location: City of Ann Arbor  
Project Number: 12940111  
Issue Date: July 25, 2007

**PROJECT  
MEMORANDUM**

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TO: **Mike Nearing, PE  
City of Ann Arbor**

FROM: **Matt Klawon, PE  
Jonathan Coleman, EI**

SUBJECT: **East Stadium Boulevard Full Closure and Emergency Closure Scenarios – DRAFT**

**1.0 INTRODUCTION**

This memorandum summarizes the recommended traffic re-allocation for the planned full closure detour and the emergency closure detour, as well as the detour route reduction methodology for the full closure detour. Due to the nature of each detour, the traffic re-allocation percentages will differ. This memorandum also highlights and explains these differences.

**2.0 TRAFFIC REALLOCATION**

The network is defined as all intersections included in the study area from Packard Street to the north, Industrial Highway to the east, I-94 to the south and Ann Arbor-Saline Road/Main Street to the west. For all detour routes, traffic volumes were redistributed throughout the network based on existing traffic patterns.

**2.1 Full Closure Detour**

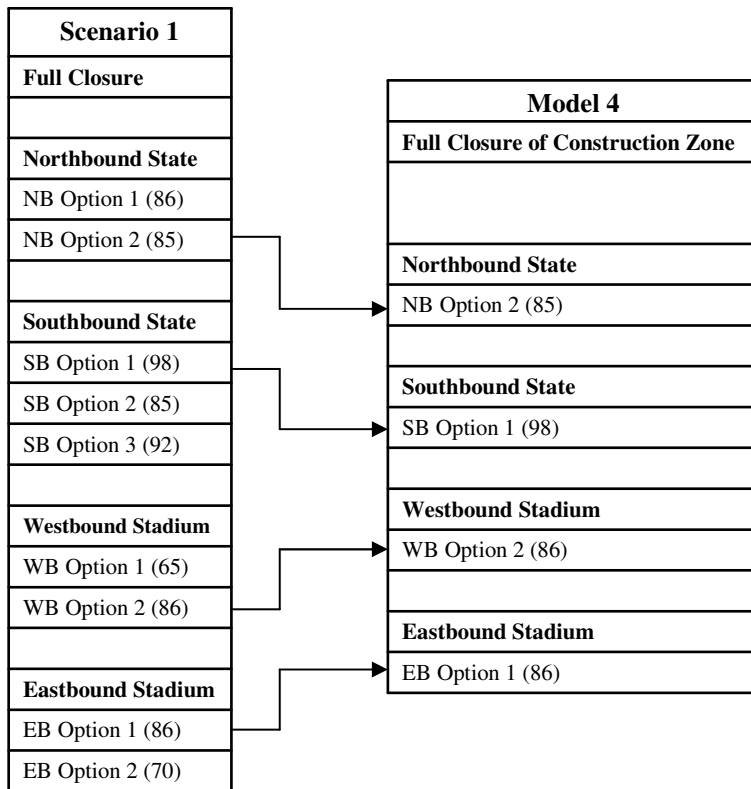
Scenario 1 was determined to be a Full Closure with the following available detour route options: two for Northbound State, three for Southbound State, two for Westbound Stadium, and two for Eastbound Stadium. Each of the route options were further reviewed by applying the weighted ranking, proposed construction staging and pro-active engineering judgment. Based on this review, the highest ranking option was not always deemed to be the most favorable option. Instead, the multiple options were reduced to the most favorable detour route option based on the overall review process. The model that resulted from this detour route deduction methodology is the Full Closure Detour (Model 4). **Figure 1** on the next page shows the detour route reduction methodology from Scenario 1 to Model 4.

Model 4 provides a detour plan to handle construction traffic if a full closure of the construction site is necessary. Model 4 is intended to operate as a planned detour route to be in place for an extended amount of time during construction with specific detour signing in place. Therefore, a percentage of traffic was canceled under this detour model. The methodology used to determine the percentage of canceled traffic and an explanation of the detour ranking was discussed in a previous memo. This memo is included in **Appendix A**.

URS began by canceling a percentage of traffic volumes at intersections closest to the closure points and worked farther away, intersection by intersection, until the percentage of traffic was canceled on the entire network. For detoured traffic volumes, URS used a similar methodology of removing traffic volumes from movements approaching the closure and redistributing the volumes along movements on detour routes. Finally, URS redistributed traffic to logical destination points within the network, and in all scenarios local traffic was maintained past the soft closure up to the hard closure. For example, with an eastbound detour in place, the soft closure would occur at the Stadium Boulevard/Main Street intersection; however, local traffic would still proceed past the soft closure to reach a residence, a golf course parking lot or the stadium parking lot.

Outbound traffic is defined as traffic that would have traveled through the closure if the closure were not in effect. A percentage of the total outbound traffic from the closure for both the AM and PM peak-hour periods has been assigned to each alternate route in the following sections.

**FIGURE 1  
DETOUR REDUCTION METHODOLOGY FOR FULL CLOSURE**



**2.1.1 Northbound Option 2**

If northbound State Street traffic is prohibited under the Stadium Boulevard Bridge, then northbound traffic must use an alternate route or avoid the area altogether:

- 20-25% of all outbound traffic is diverted from northbound State Street to eastbound Stimson Street to northbound Industrial Highway to eastbound Stadium Boulevard to north-westbound Packard Street to northbound State Street
- 20% of all outbound traffic is diverted to Eisenhower Parkway to reach logical destination points
- 20% of all outbound traffic is diverted from northbound State Street to eastbound Stimson Street to northbound Industrial Highway to eastbound Stadium Parkway to north-westbound Packard Street to specific points where traffic is distributed to other routes based on known originating points or logical destination points (For example, trips known to originate from the right turn movement from Dewey Street and Granger Street from northbound State Street will travel on a detour until the traffic reaches Dewey Street or Granger Street, respectively.)
- 35-40% of all outbound traffic is canceled on the network

**2.1.2 Southbound Option 1**

If southbound State Street traffic is prohibited under the Stadium Boulevard Bridge, then southbound traffic must use an alternate route or avoid the area altogether:

- 30% of all outbound traffic is diverted from southbound State Street to westbound Hill Street to southbound Main Street to eastbound Eisenhower Parkway to southbound State Street
- 10% of all outbound traffic is diverted from southbound State Street to south-eastbound Packard Street to westbound Stadium Boulevard to southbound Industrial Highway to westbound Stimson Street to southbound State Street
- 15-20% of all outbound traffic is diverted from southbound State Street to a specific detour route based on known originating point or logical destination point (For example, trips known to originate from the left turn movement at Dewey Street and Granger Street onto southbound State Street will travel with the residential area to reach Park Street and will follow southbound Industrial Highway to westbound Stimson Street to the assumed destination of southbound State Street.)
- 40-45% of all outbound traffic is canceled on the network

### 2.1.3 Westbound Option 2

If westbound Stadium Boulevard traffic is prohibited over the Stadium Boulevard Bridge, then westbound traffic must use an alternate route or avoid the area altogether:

- 30% of all outbound traffic is diverted from westbound Stadium Boulevard to southbound Industrial Highway to westbound Eisenhower Parkway to northbound Main Street to westbound Stadium Boulevard
- 10-20% of all outbound traffic is diverted from westbound Stadium Boulevard to north-westbound Packard Street to eastbound Hill Street to southbound Main Street to westbound Stadium Boulevard
- 50-60% of all outbound traffic is canceled on the network

### 2.1.4 Eastbound Option 1

If eastbound Stadium Boulevard traffic is prohibited over the Stadium Boulevard Bridge, then eastbound traffic must use an alternate route or avoid the area altogether:

- 30% of all outbound traffic is diverted from eastbound Stadium Boulevard to southbound Main Street to eastbound Eisenhower Parkway to northbound Industrial Highway to eastbound Stadium Boulevard
- 10% of all outbound traffic is diverted from eastbound Stadium Boulevard to northbound Main Street to eastbound Hill Street to south-eastbound Packard Street to eastbound Stadium Boulevard
- 60% of all outbound traffic is canceled on the network

## 2.2 Emergency Closure Detour

In the event that an emergency closure of the Stadium Boulevard Bridge over State Street is required, all State Street and Stadium Boulevard traffic must use an alternate route around the closure to reach its ultimate destination points. To determine these alternate routes, URS used existing traffic volume patterns and utilized sound traffic engineering judgment. Traffic was assumed to *not* follow the shortest path through neighborhood streets near the hard closure as it is anticipated that the city of Ann Arbor would place closure barricades and law enforcement as necessary to prohibit these movements upon notification of the closure. In addition, it is anticipated that the city of Ann Arbor would place road closure signing at key intersections to prohibit vehicles from entering the hard closure. This detour would be short-term in nature, unexpected and detour routes would not be signed. Therefore, no percentage of traffic was canceled under this detour option.

Outbound traffic is defined as traffic that would have traveled through the closure if the closure were not in effect. A percentage of the total outbound traffic from the closure for both the AM and PM peak-hour periods has been assigned to each alternate route below.

### **2.2.1 Northbound Alternate Routes**

If northbound State Street traffic is prohibited under the Stadium Boulevard Bridge, then northbound traffic must use an alternate route:

- 60% of all outbound traffic is diverted from northbound State Street to eastbound Stimson Street to northbound Industrial Highway to eastbound Stadium Boulevard to north-westbound Packard Street to northbound State Street
- 20% of all outbound traffic is diverted from northbound State Street to eastbound Eisenhower Parkway to northbound Industrial Highway to eastbound Stadium Boulevard to north-westbound Packard Street to northbound State Street
- 20% of all outbound traffic is diverted from northbound State Street to westbound Eisenhower Parkway (using the eastbound Eisenhower Parkway turnaround) to northbound Main Street to eastbound Hill Street to northbound State Street

### **2.2.2 Southbound Alternate Routes**

If southbound State Street traffic is prohibited under the Stadium Boulevard Bridge, then southbound traffic must use an alternate route:

- 75% of all outbound traffic is diverted from southbound State Street to westbound Hill Street to southbound Main Street to eastbound Eisenhower Parkway to southbound State Street
- 25% of all outbound traffic is diverted from southbound State Street to south-eastbound Packard Street to westbound Stadium Boulevard to southbound Industrial Highway to westbound Eisenhower Parkway to southbound State Street

### **2.2.3 Westbound Alternate Routes**

If westbound Stadium Boulevard traffic is prohibited over the Stadium Boulevard Bridge, then westbound traffic must use an alternate route:

- 25% of all outbound traffic is diverted from westbound Stadium Boulevard to southbound Industrial Highway to westbound Eisenhower Parkway to northbound Main Street to westbound Stadium Boulevard
- 25% of all outbound traffic is diverted from westbound Stadium Boulevard to north-eastbound Packard Street to westbound Hill Street to southbound Main Street to westbound Stadium Boulevard
- 50% of all outbound traffic is diverted from westbound Stadium Boulevard to southbound Industrial Highway to westbound Stimson Street to southbound State Street to westbound Eisenhower Parkway to northbound Main Street to westbound Stadium Boulevard

### **2.2.4 Eastbound Alternate Routes**

If eastbound Stadium Boulevard traffic is prohibited over the Stadium Boulevard Bridge, then eastbound traffic must use an alternate route:

- 25% of all outbound traffic is diverted from eastbound Stadium Boulevard to southbound Main Street to eastbound Eisenhower Parkway to northbound Industrial Highway to eastbound Stadium Boulevard
- 25% of all outbound traffic is diverted from eastbound Stadium Boulevard to northbound Main Street to eastbound Hill Street to south-eastbound Packard Street to eastbound Stadium Boulevard
- 50% of all outbound traffic is diverted from eastbound Stadium Boulevard to southbound Main Street to eastbound Eisenhower Parkway to northbound State Street to eastbound Stimson Street to northbound Industrial Highway to eastbound Stadium Boulevard

**3.0 CONCLUSION**

Figure 2 below presents a summary of the differences between the Full Closure Detour and the Emergency Closure Detour.

**FIGURE 2  
SUMMARY OF DIFFERENCES**

| Type           | DETOUR TYPE  |                   |
|----------------|--------------|-------------------|
|                | Full Closure | Emergency Closure |
| Duration       | Long-term    | Short-term        |
| Operation      | Planned      | Unexpected        |
| Detour Signing | Signed       | Not signed        |
| Canceled Trips | 35% - 60%    | 0%                |

**APPENDIX A  
DETOUR ROUTE REDUCTION METHODOLOGY MEMO**



Client: City of Ann Arbor  
Project Name: East Stadium Boulevard Bridge Replacement Project (Detour Evaluation)  
Location: City of Ann Arbor  
Project Number: 12940111  
Issue Date: January 17, 2007

**PROJECT  
MEMORANDUM**

TO: **Mike Nearing, PE  
City of Ann Arbor**

FROM: **Matt Klawon, PE**

SUBJECT: **East Stadium Boulevard Detour Route Reduction Methodology – DRAFT**

**1.0 INTRODUCTION**

This memorandum summarizes the reduction process that was created and implemented in order to evaluate available detour route options and scenarios to establish the top detour route options for further analysis. The reduction methodology is necessary to address the following concerns:

- Number of possible detour route scenarios exceeds the ability to accurately model each scenario.
- Project construction will be in pre-determined stages which eliminates certain detour route scenarios.
- Existing traffic demands can dictate acceptable detour route locations and directions.
- Pro-actively reduce the impact of the proposed detours by avoiding highly residential areas.

The methodology scenario presented in this memorandum is an organized and systematic approach where applying the above concerns will reduce the available detour route scenarios to a manageable number of top detour routes which will be modeled in detail.

**2.0 DETERMINATION OF ALL POSSIBLE DETOUR ROUTE SCENARIOS**

An analysis was conducted to determine all possible detour route scenarios for this project. For this memorandum a route scenario is defined as which traffic patterns are being maintained through the construction zone. For a construction project that is outside of the roadway one route scenario would be that all directions of traffic are maintained. Conversely, if this same project then required the closure of all traffic through the construction zone, an additional scenario would be where all traffic is being detoured.

Applying this principle to the traffic handling for the East Stadium Bridge project resulted in the potential for 15 detour route scenarios, which are presented in **Appendix A**.

Several detour routes were considered, for each direction of travel through the construction zone. Each route had slightly different characteristics which provided a variety between routes and allowed a systematic ranking criterion to be applied. The routes were ranked by applying a weighted ranking scale, which was developed by the project team and approved by the City in an effort to determine which route had the greatest potential of succeeding. The ranking of each route is indicated by the number in the parenthesis after each option, such as Stadium Boulevard EB Option 1 (86). In this instance, the option has a ranking of 86 out of a possible 100 points. The proposed detour routes and brief descriptions are presented in **Appendix B**.

### **3.0 DETERMINATION OF DETOUR ROUTE COMBINATIONS**

From the previous discussion of possible detour scenarios as mentioned in Section 2.0, each defined scenario has a limited number of detour combinations available based upon the number of routes available for each direction of travel. Expanding on the example discussed in Section 2.0, a detour combination could be described as applying the top detour route options for each direction of travel to be detoured around the fully closed construction zone. Another detour route combination for this fully closed construction zone scenario could be applying the top northbound and southbound routes options, while using the second best route options for westbound and eastbound movements.

An example of a detour combination for Scenario 2 would be to maintain northbound State apply southbound State Detour Option 1, apply westbound Stadium Detour Option 2, and eastbound Stadium Detour Option 1. For Scenario 2 there are a total of 12 possible detour combinations due to the multiple detour route options present.

By applying each available detour route to each of the 15 scenarios leads to a statistical determination of 105 detour combinations possible for this construction project.

### **4.0 REDUCTION PROCESS**

The 105 possible detour combinations were reduced to a list of the top detour combinations for further review by applying the weighted ranking, proposed construction staging and pro-active engineering judgment as follows.

Eastbound Stadium Option 2 and the Westbound Stadium Option 1 detour routes were considered to be unfavorable based upon the following:

- Stadium Boulevard is currently a truck route through the City of Ann Arbor.
- Physical and safety impact of commercial truck traffic being diverted along Hill Street.
- Safety concerns regarding the greater volume of pedestrian and non-motorized traffic observed along these routes, being exposed to commercial and detour traffic.
- Availability of other viable detour routes which have less impact to the university.

Southbound State Option 2 detour route was considered to be unfavorable based upon the following:

- The proximity of Hoover Street to the university
- Safety concerns regarding the greater volume of pedestrian and non-motorized traffic observed along these routes, being exposed to commercial and detour traffic.
- Intersection of Hoover and Main would likely require a temporary traffic signal to facilitate the increased westbound to southbound detoured traffic volumes.

Northbound State Option 1 detour route was considered to be unfavorable based upon the following:

- Early indications of negative public opinion regarding the utilization of Park and Granger streets.
- Potential high impact to quality of life throughout this neighborhood.
- Safety concerns regarding residential non-motorized traffic along these roadways.

Preliminary engineering and design of the construction project have indicated that there are several reasons for maintaining one direction of motorized and non-motorized traffic on Stadium Boulevard through the construction zone. It has been determined that one lane of the westbound Stadium Boulevard traffic flow will be maintained for the following reasons:

- Maintaining westbound traffic will allow for consistent access to Pioneer High School in the morning.
- Provides the necessary facilities for non-motorized access through the construction area.
- No viable alternatives for detouring of non-motorized traffic around construction site.



- Maintains the westbound truck route and the integrity of truck access to State Street (via Stimson).

Northbound State Option 2 detour route and the detouring of any northbound traffic along State Street was considered to be unfavorable for the following:

- Does not support access to the downtown business district.
- Does not assure consistent arrival times for students and commuters traveling to the downtown and University of Michigan campuses.

By maintaining one lane of northbound traffic through the construction zone, non-motorized traffic will also be provided with access through the site.

Southbound State Option 3 detour route was considered to be unfavorable for the following:

- The southbound left turn movement at State and Packard has limited capacity due to the tight spacing of existing traffic signals.
- Limited southbound left turn storage area.
- Due to northbound State Street traffic being maintained traffic signal operations may not be capable of facilitating the southbound left turn traffic at the State Street and Packard intersection.

**5.0 CONCLUSION**

After the above reductions presented in Section 4.0 were applied, the fifteen initial scenarios and 105 detour combinations become reduced to 3 scenarios/models shown below:

|                          |                            |                            |
|--------------------------|----------------------------|----------------------------|
| <b>Model 1</b>           | <b>Model 2</b>             | <b>Model 3</b>             |
| <b>NB/WB Maintained</b>  | <b>NB/WB/EB Maintained</b> | <b>NB/SB/WB Maintained</b> |
|                          |                            |                            |
| <b>Northbound State</b>  | <b>Northbound State</b>    | <b>Northbound State</b>    |
| NB Maintained            | NB Maintained              | NB Maintained              |
|                          |                            |                            |
| <b>Southbound State</b>  | <b>Southbound State</b>    | <b>Southbound State</b>    |
| SB Option 1 (98)         | SB Option 1 (98)           | SB Maintained              |
|                          |                            |                            |
| <b>Westbound Stadium</b> | <b>Westbound Stadium</b>   | <b>Westbound Stadium</b>   |
| WB Maintained            | WB Maintained              | WB Maintained              |
|                          |                            |                            |
| <b>Eastbound Stadium</b> | <b>Eastbound Stadium</b>   | <b>Eastbound Stadium</b>   |
| EB Option 1 (86)         | EB Maintained              | EB Option 1 (86)           |

Due to construction requirements and the preliminary engineering only two of the three scenarios/models shown above may be used during the construction phase of this project those scenarios are Model 1 and Model 2. It is anticipated that the staging of traffic in Model 1 will be implemented during the first stage of construction and the staging of traffic in Model 2 will be used during the second stage of construction should additional pavement width be available to maintain two directions of traffic on Stadium. Model 3 will be provided to represent a stage of construction where State Street would be open to all traffic, while Stadium Boulevard is reduced to maintaining only the westbound direction of traffic. As a contingency, URS proposes that Model 4 with full closure of the construction site be considered to provide a mitigation plan for any substantial problems which may arise during construction.

Therefore, the final models for further evaluation are outlined below.

|                          |                            |                            |                                          |
|--------------------------|----------------------------|----------------------------|------------------------------------------|
| <b>Model 1</b>           | <b>Model 2</b>             | <b>Model 3</b>             | <b>Model 4</b>                           |
| <b>NB/WB Maintained</b>  | <b>NB/WB/EB Maintained</b> | <b>NB/SB/WB Maintained</b> | <b>Full Closure of Construction Zone</b> |
|                          |                            |                            |                                          |
| <b>Northbound State</b>  | <b>Northbound State</b>    | <b>Northbound State</b>    | <b>Northbound State</b>                  |
| NB Maintained            | NB Maintained              | NB Maintained              | NB Option 2 (85)                         |
|                          |                            |                            |                                          |
| <b>Southbound State</b>  | <b>Southbound State</b>    | <b>Southbound State</b>    | <b>Southbound State</b>                  |
| SB Option 1 (98)         | SB Option 1 (98)           | SB Maintained              | SB Option 1 (98)                         |
|                          |                            |                            |                                          |
| <b>Westbound Stadium</b> | <b>Westbound Stadium</b>   | <b>Westbound Stadium</b>   | <b>Westbound Stadium</b>                 |
| WB Maintained            | WB Maintained              | WB Maintained              | WB Option 2 (86)                         |
|                          |                            |                            |                                          |
| <b>Eastbound Stadium</b> | <b>Eastbound Stadium</b>   | <b>Eastbound Stadium</b>   | <b>Eastbound Stadium</b>                 |
| EB Option 1 (86)         | EB Maintained              | EB Option 1 (86)           | EB Option 1 (86)                         |

**APPENDIX A  
DETOUR ROUTE SCENARIOS**

**The 15 Possible Detour Scenarios**

|                          |
|--------------------------|
| <b>Scenario 1</b>        |
| <b>Full Closure</b>      |
|                          |
| <b>Northbound State</b>  |
| NB Option 1 (86)         |
| NB Option 2 (85)         |
|                          |
| <b>Southbound State</b>  |
| SB Option 1 (98)         |
| SB Option 2 (85)         |
| SB Option 3 (92)         |
|                          |
| <b>Westbound Stadium</b> |
| WB Option 1 (65)         |
| WB Option 2 (86)         |
|                          |
| <b>Eastbound Stadium</b> |
| EB Option 1 (86)         |
| EB Option 2 (70)         |

|                          |
|--------------------------|
| <b>Scenario 2</b>        |
| <b>NB Maintained</b>     |
|                          |
| <b>Northbound State</b>  |
| NB Maintained            |
|                          |
| <b>Southbound State</b>  |
| SB Option 1 (98)         |
| SB Option 2 (85)         |
| SB Option 3 (92)         |
|                          |
| <b>Westbound Stadium</b> |
| WB Option 1 (65)         |
| WB Option 2 (86)         |
|                          |
| <b>Eastbound Stadium</b> |
| EB Option 1 (86)         |
| EB Option 2 (70)         |

|                          |
|--------------------------|
| <b>Scenario 3</b>        |
| <b>SB Maintained</b>     |
|                          |
| <b>Northbound State</b>  |
| NB Option 1 (86)         |
| NB Option 2 (85)         |
|                          |
| <b>Southbound State</b>  |
| SB Maintained            |
|                          |
| <b>Westbound Stadium</b> |
| WB Option 1 (65)         |
| WB Option 2 (86)         |
|                          |
| <b>Eastbound Stadium</b> |
| EB Option 1 (86)         |
| EB Option 2 (70)         |

|                          |
|--------------------------|
| <b>Scenario 4</b>        |
| <b>WB Maintained</b>     |
|                          |
| <b>Northbound State</b>  |
| NB Option 1 (86)         |
| NB Option 2 (85)         |
|                          |
| <b>Southbound State</b>  |
| SB Option 1 (98)         |
| SB Option 2 (85)         |
| SB Option 3 (92)         |
|                          |
| <b>Westbound Stadium</b> |
| WB Maintained            |
|                          |
| <b>Eastbound Stadium</b> |
| EB Option 1 (86)         |
| EB Option 2 (70)         |

|                          |
|--------------------------|
| <b>Scenario 5</b>        |
| <b>EB Maintained</b>     |
|                          |
| <b>Northbound State</b>  |
| NB Option 1 (86)         |
| NB Option 2 (85)         |
|                          |
| <b>Southbound State</b>  |
| SB Option 1 (98)         |
| SB Option 2 (85)         |
| SB Option 3 (92)         |
|                          |
| <b>Westbound Stadium</b> |
| WB Option 1 (65)         |
| WB Option 2 (86)         |
|                          |
| <b>Eastbound Stadium</b> |
| EB Maintained            |
|                          |

|                          |
|--------------------------|
| <b>Scenario 6</b>        |
| <b>NB/SB Maintained</b>  |
|                          |
| <b>Northbound State</b>  |
| NB Maintained            |
|                          |
| <b>Southbound State</b>  |
| SB Maintained            |
|                          |
| <b>Westbound Stadium</b> |
| WB Option 1 (65)         |
| WB Option 2 (86)         |
|                          |
| <b>Eastbound Stadium</b> |
| EB Option 1 (86)         |
| EB Option 2 (70)         |

|                          |
|--------------------------|
| <b>Scenario 7</b>        |
| <b>NB/WB Maintained</b>  |
|                          |
| <b>Northbound State</b>  |
| NB Maintained            |
|                          |
| <b>Southbound State</b>  |
| SB Option 1 (98)         |
| SB Option 2 (85)         |
| SB Option 3 (92)         |
|                          |
| <b>Westbound Stadium</b> |
| WB Maintained            |
|                          |
| <b>Eastbound Stadium</b> |
| EB Option 1 (86)         |
| EB Option 2 (70)         |

|                          |
|--------------------------|
| <b>Scenario 8</b>        |
| <b>NB/EB Maintained</b>  |
|                          |
| <b>Northbound State</b>  |
| NB Maintained            |
|                          |
| <b>Southbound State</b>  |
| SB Option 1 (98)         |
| SB Option 2 (85)         |
| SB Option 3 (92)         |
|                          |
| <b>Westbound Stadium</b> |
| WB Option 1 (65)         |
| WB Option 2 (86)         |
|                          |
| <b>Eastbound Stadium</b> |
| EB Maintained            |
|                          |

|                          |
|--------------------------|
| <b>Scenario 9</b>        |
| <b>WB/EB Maintained</b>  |
|                          |
| <b>Northbound State</b>  |
| NB Option 1 (86)         |
| NB Option 2 (85)         |
|                          |
| <b>Southbound State</b>  |
| SB Option 1 (98)         |
| SB Option 2 (85)         |
| SB Option 3 (92)         |
|                          |
| <b>Westbound Stadium</b> |
| WB Maintained            |
|                          |
|                          |
| <b>Eastbound Stadium</b> |
| EB Maintained            |
|                          |

|                          |
|--------------------------|
| <b>Scenario 10</b>       |
| <b>SB/WB Maintained</b>  |
|                          |
| <b>Northbound State</b>  |
| NB Option 1 (86)         |
| NB Option 2 (85)         |
|                          |
| <b>Southbound State</b>  |
| SB Maintained            |
|                          |
|                          |
| <b>Westbound Stadium</b> |
| WB Maintained            |
|                          |
|                          |
| <b>Eastbound Stadium</b> |
| EB Option 1 (86)         |
| EB Option 2 (70)         |

|                          |
|--------------------------|
| <b>Scenario 11</b>       |
| <b>SB/EB Maintained</b>  |
|                          |
| <b>Northbound State</b>  |
| NB Option 1 (86)         |
| NB Option 2 (85)         |
|                          |
| <b>Southbound State</b>  |
| SB Maintained            |
|                          |
|                          |
| <b>Westbound Stadium</b> |
| WB Option 1 (65)         |
| WB Option 2 (86)         |
|                          |
|                          |
| <b>Eastbound Stadium</b> |
| EB Maintained            |
|                          |

|                            |
|----------------------------|
| <b>Scenario 12</b>         |
| <b>NB/SB/WB Maintained</b> |
|                            |
| <b>Northbound State</b>    |
| NB Maintained              |
|                            |
|                            |
| <b>Southbound State</b>    |
| SB Maintained              |
|                            |
|                            |
| <b>Westbound Stadium</b>   |
| WB Maintained              |
|                            |
|                            |
| <b>Eastbound Stadium</b>   |
| EB Option 1 (86)           |
| EB Option 2 (70)           |

|                            |
|----------------------------|
| <b>Scenario 13</b>         |
| <b>NB/SB/EB Maintained</b> |
|                            |
| <b>Northbound State</b>    |
| NB Maintained              |
|                            |
|                            |
| <b>Southbound State</b>    |
| SB Maintained              |
|                            |
|                            |
| <b>Westbound Stadium</b>   |
| WB Option 1 (65)           |
| WB Option 2 (86)           |
|                            |
|                            |
| <b>Eastbound Stadium</b>   |
| EB Maintained              |
|                            |

|                            |
|----------------------------|
| <b>Scenario 14</b>         |
| <b>NB/WB/EB Maintained</b> |
|                            |
| <b>Northbound State</b>    |
| NB Maintained              |
|                            |
|                            |
| <b>Southbound State</b>    |
| SB Option 1 (98)           |
| SB Option 2 (85)           |
| SB Option 3 (92)           |
|                            |
|                            |
| <b>Westbound Stadium</b>   |
| WB Maintained              |
|                            |
|                            |
| <b>Eastbound Stadium</b>   |
| EB Maintained              |
|                            |

|                            |
|----------------------------|
| <b>Scenario 15</b>         |
| <b>SB/WB/EB Maintained</b> |
|                            |
| <b>Northbound State</b>    |
| NB Option 1 (86)           |
| NB Option 2 (85)           |
|                            |
|                            |
| <b>Southbound State</b>    |
| SB Maintained              |
|                            |
|                            |
| <b>Westbound Stadium</b>   |
| WB Maintained              |
|                            |
|                            |
| <b>Eastbound Stadium</b>   |
| EB Maintained              |
|                            |

**APPENDIX B  
DESCRIPTION OF DETOUR ROUTES**

# EAST STADIUM BLVD. BRIDGES REPLACEMENT

Potential Detour Routes  
for State Street and Stadium Boulevard

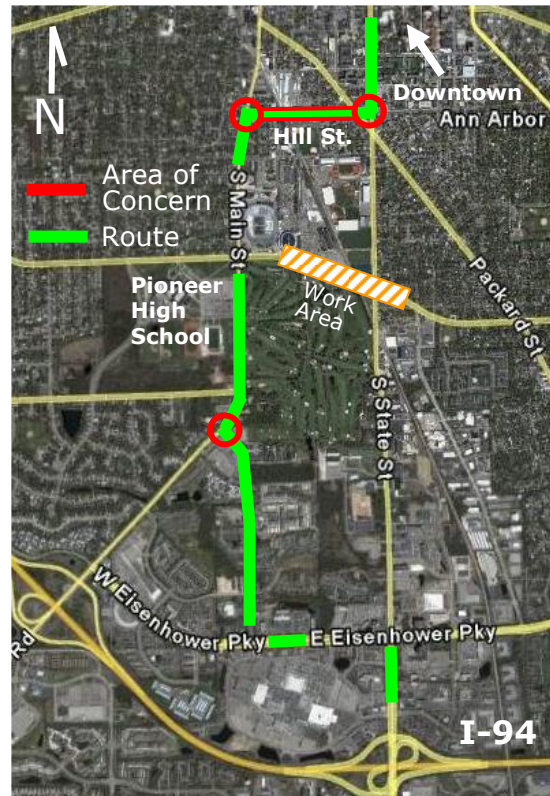
Preliminary & Advisory  
URS Corporation  
January 17, 2007

# Southbound State Street Detour

## Route Option #1

### Option #1 Route Highlights:

- The first turn of the detour from State Street will be a right turn onto Hill Street which will allow for sufficient capacity.
- The second turn will be a left turn at the traffic signal of South Main Street where Hill Street ends.
- The intersection of South Main Street and Ann Arbor Saline Road has dual southbound left turn lanes to support detour traffic.
- Southbound State Street is not designated as a truck route at the point where this detour begins.
- Concerns regarding truck traffic on Hill Street and Main Street south of Ann Arbor Saline may be omitted, since the beginning of the detour route is not on an established truck route.



The proposed route shown above is South State to Hill Street to South Main Street to East Eisenhower Parkway to South State Street.

### Detour Route Ranking Score 98

**Recommendation:** This route appears to have the necessary facilities to handle the additional traffic volumes from the detour route and will have the least amount of impact to residents/businesses currently along this route. Hill Street is the only roadway in this proposed route that is not usually subjected to higher traffic volumes. Hill Street serves a mixture of residential and University buildings and is not a truck route. Detour traffic along this roadway will be comprised of private passenger vehicles and local delivery commercial traffic.

The traffic signal at the intersection of Hill Street and South Main would be re-timed to provide adequate capacity for the westbound to southbound detour movement. Concerns regarding the potential reductions in capacity that may occur on South Main Street due to the University of Michigan Stadium project will need to be addressed and coordinated with the University's project.

A preliminary review has indicated that this movement can be maintained through the construction zone for the duration of the project. This option should be investigated further and be included in the modeling and research of mitigation measures which would make this detour route successful if selected.

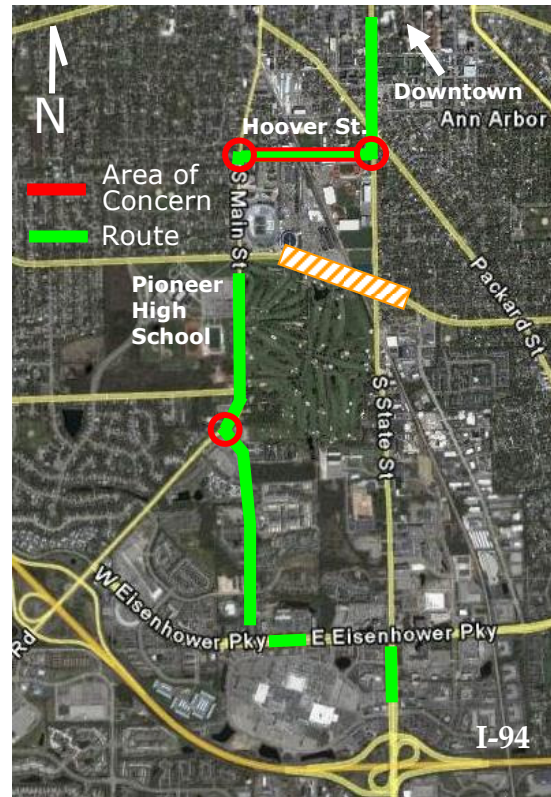


# Southbound State Street Detour

## Route Option #2

### Option #2 Route Highlights:

- The first turn of the detour from State Street will be a right turn onto Hoover Street which will allow for sufficient capacity. This right turn lane has greater storage than the southbound right turn at State and Hill Street.
- The second turn will be a left turn at South Main Street where Hoover Street ends.
- The intersection of South Main Street and Ann Arbor Saline Road has dual southbound left turn lanes to support detour traffic.
- Southbound State Street is not designated as a truck route at the point where this detour begins.
- Concerns regarding truck traffic on Hoover Street and Main Street south of Ann Arbor Saline may be omitted, since the beginning of the detour route is not on an established truck route.



The proposed route shown above is South State to Hoover Street to South Main Street to East Eisenhower Parkway to South State Street.

### Detour Route Ranking Score 85

**Recommendation:** This route appears to have the necessary facilities to handle the additional traffic volumes from the detour route and will have a minimal impact to residents/businesses currently along this route. Hoover Street is the only roadway in this proposed route that is not usually subjected to higher traffic volumes. Hoover Street serves a mixture of residential and University buildings and is not a truck route. Detour traffic along this roadway will be comprised of private passenger vehicles and local delivery commercial traffic, however this roadway is considered to be in the University of Michigan Campus and has higher volumes of pedestrian and bicycle traffic than Hill Street.

A temporary traffic signal may be necessary at the intersection of Hoover Street and South Main. The South Main and Pauline signal may need to be coordinated to facilitate the temporary signal at Hoover Street. Concerns regarding the potential reductions in capacity that may occur on South Main Street due to the University of Michigan Stadium project will need to be addressed and coordinated with the University's project.

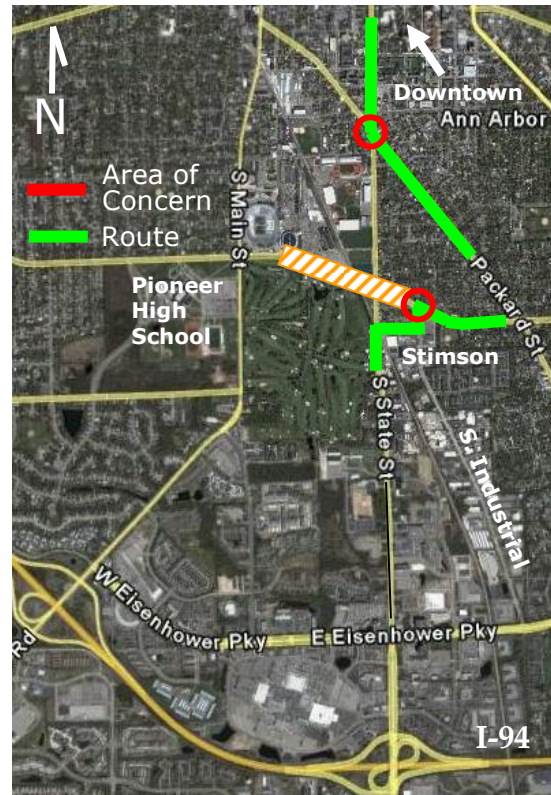
A preliminary review has indicated that this movement can be maintained through the construction zone for the duration of the project. This option should be investigated further and be included in the modeling and research of mitigation measures which would make this detour route successful if selected.

# Southbound State Street Detour

## Route Option #3

### Option #3 Route Highlights:

- The first turn of the detour from State Street will be a left turn onto Packard Street. This left turn movement may not provide enough capacity for the detour movement.
- The second turn will be a right turn from Packard to Stadium. This movement should not hinder the detour traffic.
- The intersection of Stadium at Industrial, Stimson at Industrial and Stimson at State would be retimed to handle the additional detour traffic at these intersections.
- Concerns regarding commercial traffic on this route may be omitted, since State Street is not a truck route. Packard, Stadium, South Industrial, Stimson are designated truck routes.



The proposed route shown above is South State to Packard Street to Stadium to South Industrial to Stimson to South State Street.

### Detour Route Ranking Score 92

**Recommendation:** This route appears to be a candidate for a potential detour route, however there may be capacity limitations for the southbound left turn movement from State to Packard. If further analysis indicates that there would be a reduction in the opposing northbound traffic, this limitation may be overcome. Detour traffic along this roadway will be comprised of private passenger vehicles and local delivery commercial traffic.

It is anticipated that this detour route would overlap with other detour routes for this project, such as the Eastbound Stadium detour route and northbound State Street routes. This overlapping would significantly affect the operation of the traffic signals of Stadium at South Industrial and Stadium at Packard, due to increased traffic demand.

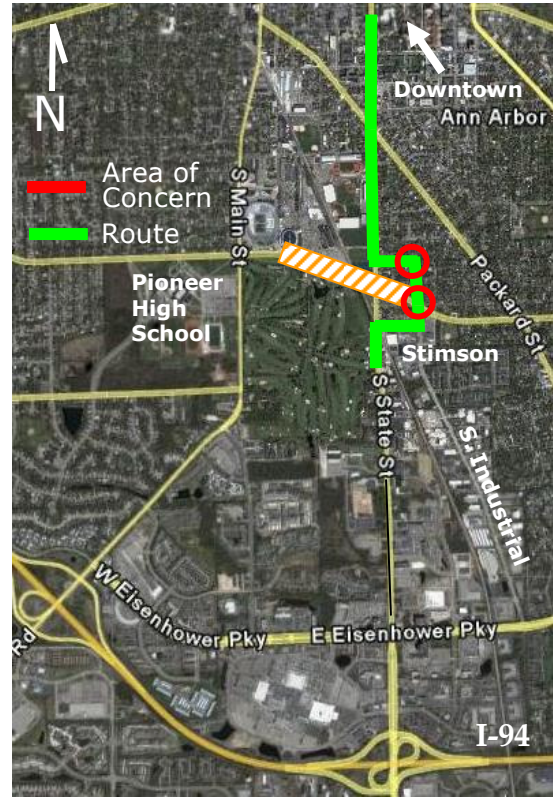
A preliminary review has indicated that this movement can be maintained through the construction zone for the duration of the project. URS is recommending that this option be omitted from further investigation due to the limited capability of the State and Packard intersection operating effectively under the detour conditions and the availability of other exclusive detour route paths for the southbound State Street traffic.

# Northbound State Street Detour

## Route Option #1

### Option #1 Route Highlights:

- This route provides the shortest distance for detouring the northbound traffic around the project.
- It is believed that the timing of the signalized intersections could be modified to handle the detour traffic along this route.
- The area north of Stadium Street, from Park to Granger is a residential area. Significant community agreement would be necessary to allow this detour traffic to travel this route.
- All northbound commercial traffic is currently required to make the right turn off of State onto Stimson. The northbound truck route on State Street ends at Stimson. Therefore detouring the truck traffic is not necessary.



The proposed route shown above is South State to Stimson to South Industrial to Park to Granger to South State Street.

### Detour Route Ranking Score 86

**Recommendation:** This route appears to be a candidate for a potential detour route, however detouring of traffic through the residential area would require significant public approval. Detour traffic along this roadway will be comprised of private passenger vehicles and local delivery commercial traffic, all heavy truck traffic would be required to seek a different route as they are currently doing.

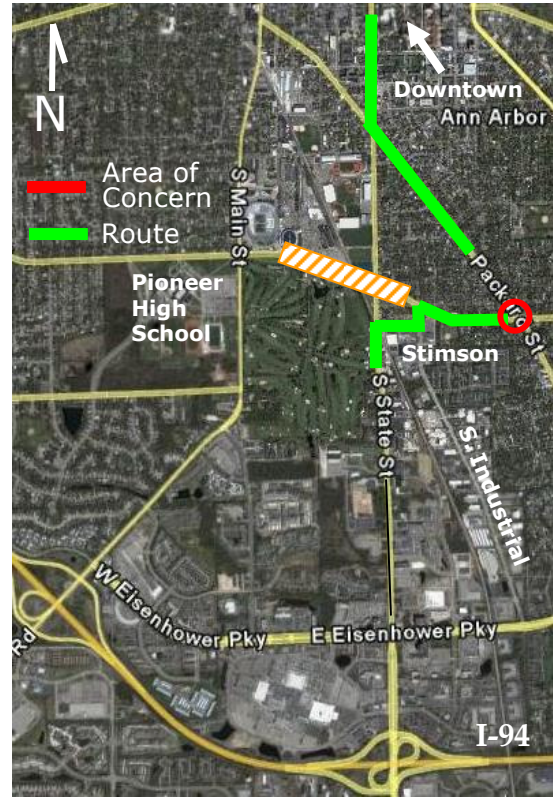
A preliminary review has indicated that this movement can be maintained through the construction zone for the duration of the project. URS is recommending that this option be investigated further. There should be a careful approach to the amount of resources allocated to this investigation until the public opinion is weighed and this detour route is accepted by the residents in this area.

# Northbound State Street Detour

## Route Option #2

### Option #2 Route Highlights:

- This route will detour traffic along main roadways, however the route is longer and will incur more delay overall.
- It is believed that the timings of the signalized intersections could be modified to handle the detour traffic along this route.
- The eastbound Stadium to northbound Packard movement will be of concern specifically regarding the ability of commercial traffic to negotiate the turn safely.
- The intersection of Stadium and Packard will need to be re-timed to handle the increased eastbound left turn traffic.



The proposed route shown above is South State to Stimson to South Industrial to Stadium to Packard to South State Street.

### Detour Route Ranking Score 85

**Recommendation:** This route appears to be the most publicly acceptable detour route. It will require more time than the other option and will also pose specific challenges in the optimization of the traffic signals to facilitate the detour movements through the intersections. Detour traffic along this roadway will be comprised of private passenger vehicles, local delivery commercial traffic, and some heavy truck traffic.

A preliminary review has indicated that this movement can be maintained through the construction zone for the duration of the project. URS is recommending that this option be investigated further and be included in the modeling and research of mitigation measures which would make this detour route successful if selected.

# Eastbound Stadium Blvd Detour

## Route Option #1

### Option #1 Route Highlights:

- This route will detour traffic along main roadways.
- It is anticipated that the timings of the signalized intersections could be modified to handle the detour traffic along this route.
- The intersection of Stadium and South Industrial will need to be re-timed to handle the increased eastbound left turn traffic.
- There may be a concern regarding the capacity of the eastbound left turn movement from Eisenhower to South Industrial.
- Stadium is currently a truck route, while portions of South Main and Eisenhower are not.



The proposed route shown above is Stadium to South Main to Eisenhower to South Industrial to Stadium.

### Detour Route Ranking Score 86

**Recommendation:** This route appears to be a good candidate for a potential detour, however the capacity of the eastbound left turn movement at Eisenhower and South Industrial will require further investigation. Detour traffic along this roadway will be comprised of private passenger vehicles and local delivery commercial traffic. Additional accommodations for the commercial traffic on Stadium will need to be made if the traffic cannot be routed down South Main or Eisenhower.

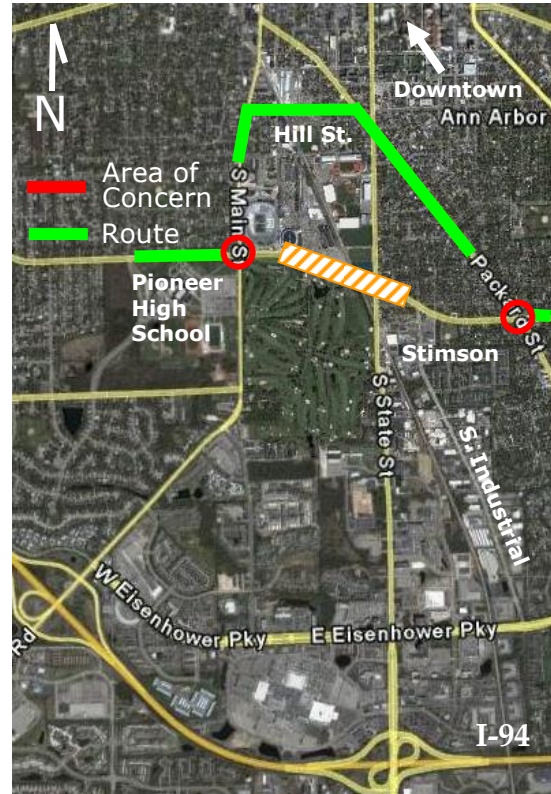
URS is recommending that this option be investigated further and be included in the modeling and research of mitigation measures which would make this detour route successful if selected.

# Eastbound Stadium Blvd Detour

## Route Option #2

### Option #2 Route Highlights:

- The first turn of the detour from Stadium will be a left turn onto South Main which may restrict the capacity of the detour route.
- The use of Hill Street may require significant approval from citizens and public groups due to the additional traffic demand.
- Concerns regarding commercial traffic on Hill Street will need to be addressed, since this traffic type will be need to be a part of the detoured traffic.
- The southbound left turn from Packard onto Stadium may require additional traffic signal retiming.
- The University of Michigan project may have a substantial impact on this route, coordination will be necessary.



The proposed route shown above is Stadium to South Main to Hill to Packard to Stadium.

### Detour Route Ranking Score 70

**Recommendation:** This route appears to have the necessary facilities to handle the additional traffic volumes from the detour route and will have the least amount of impact to residents/businesses currently along this route. Hill Street is the only roadway in this proposed route that is not usually subjected to higher traffic volumes. Hill Street is a mixture of residential and University buildings and is not part of the truck routes in Ann Arbor. Detour traffic along this roadway will be comprised of private passenger vehicles and local delivery commercial traffic. Additional accommodations for the heavy truck traffic on Stadium will need to be made if the traffic cannot be routed down Hill Street.

The traffic signal at the intersection of Stadium and South Main would be re-timed to provide adequate capacity for the eastbound to northbound detour movement. Concerns regarding the potential reductions in capacity that may occur on South Main Street due to the University of Michigan Stadium project will need to be addressed and coordinated with the University's project.

URS is recommending that this option be investigated further and be included in the modeling and research of mitigation measures which would make this detour route successful if selected.

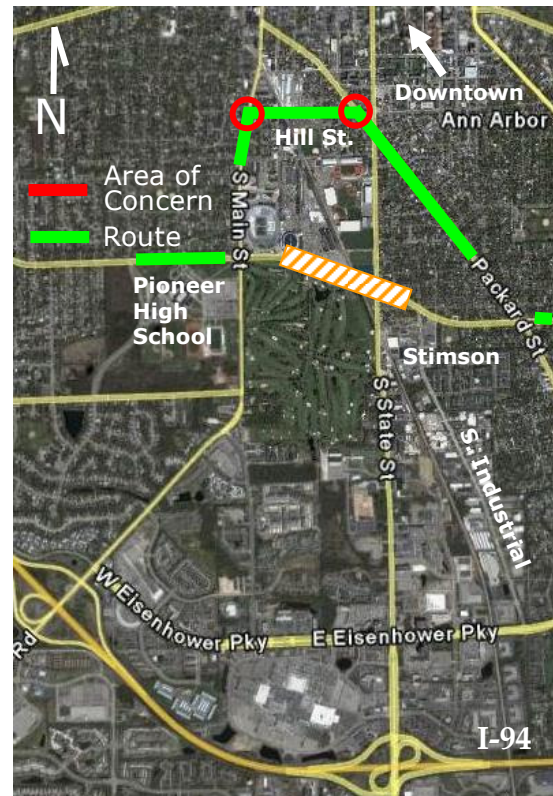
Preliminary & Advisory  
URS Corporation  
Jan 17, 2007

# Westbound Stadium Blvd Detour

## Route Option #1

### Option #1 Route Highlights:

- The first turn of the detour from Stadium will be a right turn onto South Main which should allow for sufficient capacity.
- The left turn movement from Packard onto Hill may prove to be unable to accommodate the detour movement.
- The use of Hill Street may require significant approval from citizens and public groups due to the additional traffic demand.
- Concerns regarding commercial traffic on Hill Street will need to be addressed, since this traffic type will be a part of the detoured traffic.
- The University of Michigan project may have a substantial impact on this route, coordination will be necessary.



The proposed route shown above is Stadium to Packard to Hill to South Main to Stadium.

### Detour Route Ranking Score 65

**Recommendation:** Areas of concern along this route include the northbound Packard left turn onto Hill Street, due to the limited capacity at this intersection, this movement may prove to be inadequate in handling the detour traffic. Of the roadways in this route, Hill Street is the only roadway that is not usually subjected to higher traffic volumes. Hill Street is a mixture of residential and University buildings and is not part of the truck routes in Ann Arbor. Detour traffic along this roadway will be comprised of private passenger vehicles and local delivery commercial traffic. Additional accommodations for the commercial traffic on Stadium will need to be made if the traffic cannot be routed down Hill Street.

Concerns regarding the potential reductions in capacity that may occur on South Main Street due to the University of Michigan Stadium project will need to be addressed and coordinated with the University's project.

URS is recommending that the westbound Stadium traffic movement be maintained through the construction zone for the duration of the project. This movement is a primary inbound movement for Pioneer High School and preliminary review has indicated that this movement can be maintained during construction. This option should be investigated further and be included in the modeling and research of mitigation measures which would make this detour route successful if selected.

Preliminary & Advisory  
URS Corporation  
Jan 17, 2007

# Westbound Stadium Blvd Detour

## Route Option #2

### Option #2 Route Highlights:

- This route will detour traffic along main roadways.
- It is believed that the timings of the signalized intersections could be modified to handle the detour traffic along this route.
- The intersection of Stadium and South Industrial will need to be re-timed to handle the increased westbound left turn traffic.
- There may be a concern regarding the capacity of the northbound left turn movement from South Main to Stadium.
- Sections of this route are not designated truck routes and this will need to be addressed as truck traffic will be need to be a part of the detour.



The proposed route shown above is Stadium to South Industrial to Eisenhower to South Main to Stadium.

### Detour Route Ranking Score 86

**Recommendation:** Areas of concern along this route include the westbound Stadium left turn onto South Industrial, this movement may prove to be inadequate in handling the detour traffic if the traffic signal timing cannot be modified to accommodate the volumes. Detour traffic along this roadway will be comprised of private passenger vehicles and local delivery commercial traffic. Additional accommodations for the heavy truck traffic on Stadium will need to be made if the traffic cannot be routed along this route.

Concerns regarding the potential reductions in capacity that may occur on South Main Street due to the University of Michigan Stadium project will need to be addressed and coordinated with the University's project.

URS is recommending that the westbound Stadium traffic movement be maintained through the construction zone for the duration of the project. This movement is a primary inbound movement for Pioneer High School and preliminary review has indicated that this movement can be maintained during construction. This option should be investigated further and be included in the modeling and research of mitigation measures which would make this detour route successful if selected.

Preliminary & Advisory  
URS Corporation  
Jan 17, 2007



## **Considerations for maintaining northbound State Street during construction.**

- Facilitates the morning peak traffic movements into the city.
- Allows for commuters to have consistent arrival times for work and school.
- Supports the downtown business district.
- Provides access through the construction zone for non-motorized traffic.

## **Considerations for maintaining westbound Stadium Boulevard during construction.**

- Maintains the inbound route in the morning commute to Pioneer High School. This aides in assuring that the start times for the school will be maintained by consistent bus arrivals.
- Maintains access by both the westbound and eastbound Stadium Avenue traffic to the University parking facilities located east of the stadium and the golf course to the south.
- Provides the necessary facilities for non-motorized access through the construction area.
- No viable alternatives for detouring of non-motorized traffic around construction site.
- Maintains the westbound truck route and the integrity of truck access to State Street (via Stimson).



Client: **City of Ann Arbor**  
Project Name: **East Stadium Boulevard  
Improvements Project**  
Location: **City of Ann Arbor**  
Project Number: **12940111**  
Issue Date: **August 21, 2007**

**PROJECT  
MEMORANDUM**

TO: **Mike Nearing, PE**  
**City of Ann Arbor**

FROM: **Matt Klawon, PE**  
**Jonathan Coleman, EIT**

SUBJECT: **East Stadium Boulevard Emergency Bridge Closure Evaluation**

In order to quantify intersection traffic operations, existing Level of Service (LOS) values were determined using the industry-standard methodology presented in the *Highway Capacity Manual (2000 Edition)*, published by the Transportation Research Board. The *Synchro* software package, based on the *Highway Capacity Manual* methodologies, was used in the analysis.

The term "Level of Service" denotes how well (or poorly) a traffic movement operates under given traffic demands, lane arrangements, and traffic controls. Each level is determined by the average amount of control delay per vehicle. Control delay is the total delay associated with stopping for a signal, and includes four components; deceleration delay, queue move up time, stopped delay and final acceleration delay. LOS "D" or better is considered acceptable in urban or suburban communities like the City of Ann Arbor. A summary is presented in **Table 1**.

**TABLE 1  
LEVEL-OF-SERVICE CRITERIA AT SIGNALIZED INTERSECTIONS**

| <b>Level of Service (LOS)</b> | <b>Average Control Delay (sec/veh)</b> | <b>Description</b>                                                                                                                       |
|-------------------------------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| A                             | <10                                    | Low vehicle delays, high progression of vehicles along corridor                                                                          |
| B                             | 10-20                                  | Low vehicle delays, good progression of vehicles along corridor                                                                          |
| C                             | 20-35                                  | Higher vehicle delays, significant number of stopped vehicles, not all vehicles in a queue are serviced by green signal phase            |
| D                             | 35-55                                  | Congestion noticeable, longer vehicle delays, many vehicles stop at signals, many individual cycle failures                              |
| E                             | 55-80                                  | High vehicle delays, poor corridor progression, frequent individual cycle failures                                                       |
| F                             | 80>                                    | Vehicle flow exceeds lane capacity, significant congestion and vehicle delays, poor corridor progression, many individual cycle failures |

Source: *Highway Capacity Manual*, TRB, 2000.

Three key intersections along Stadium Boulevard, as shown in **Figure 1** on page 3, were chosen to illustrate the decline in traffic operations immediately after the Emergency Closure of the Stadium Boulevard Bridge resulting in a full closure of State Street and Stadium Boulevard and then the improvement in the traffic operations over time. The improvement in operations would occur due to the establishment of detour routes, reduced traffic volumes due to discretionary (will not occur) trips, vehicles finding alternate routes and ultimately, signal timing and intersection geometric modifications to favor the detour routes and additional congested areas. Four traffic scenarios were analyzed and are summarized in **Table 2**.

**Figure 2** and **Figure 3** present each signalized intersection that was analyzed as part of the project for the four traffic scenarios and document the cycle length, the LOS, the Average Control Delay, and the percent change between the different scenarios for the AM and PM Peak Periods, respectively.

**TABLE 2  
 EXPLANATION OF ANALYSIS SCENARIOS**

| <b>Traffic Scenarios</b>        | <b>Anticipated Timeframe</b>                   | <b>Measures Implemented (Bold: Engineering Measures)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Existing                        | Before Closure                                 | <ul style="list-style-type: none"> <li>• None</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>EMERGENCY BRIDGE CLOSURE</b> |                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Emergency Closure               | 0-24 hours after Closure                       | <ul style="list-style-type: none"> <li>• None</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Short Term                      | 24 hours to 2 weeks after Closure              | <ul style="list-style-type: none"> <li>• None; however, reduced traffic volumes due to discretionary (will not occur) trips will improve operations</li> </ul>                                                                                                                                                                                                                                                                                                                                                   |
| Long Term                       | 2 weeks after closure until route is re-opened | <ul style="list-style-type: none"> <li>• Reduced traffic volumes due to discretionary (will not occur) trips will improve operations</li> <li>• <b>Detour routes established with applicable signing</b></li> <li>• Vehicles remaining following detour routes</li> <li>• <b>Signal timing modifications to favor detour routes and additional congested areas</b></li> <li>• <b>Intersection geometric modifications (including lane usage changes and additional signal equipment installation)</b></li> </ul> |

Source: URS Corporation, 2007.

**Table 3** lists the intersections requiring engineering measures to alleviate congested areas along the detour routes. Although these measures will not restore the operations to existing conditions (in most cases), implementing the modifications will reduce delay and minimize queue lengths.

**TABLE 3  
 LONG TERM TRAFFIC SCENARIO ENGINEERING MEASURES**

| <b>Modifications</b>                                 | <b>Intersection</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lane Assignment, Pavement Markings and Traffic Signs | <ul style="list-style-type: none"> <li>• Stadium Blvd &amp; Main</li> <li>-- EB Stadium Shared Thru + Right Turn Lane to Right Turn Only Lane</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                               |
| Signal Phasing                                       | <ul style="list-style-type: none"> <li>• Eisenhower &amp; Main</li> <li>-- SB Left Turn from Permitted to Split</li> <li>• Stadium Blvd &amp; Main</li> <li>-- EB Right Turn from Protected + Overlap to Protected</li> </ul>                                                                                                                                                                                                                                                                                                                          |
| Signal Timing                                        | <ul style="list-style-type: none"> <li>• Stadium &amp; Packard</li> <li>• Scio Church &amp; Main</li> <li>• Eisenhower Pkwy &amp; Main</li> <li>• Main &amp; Ann Arbor-Saline</li> <li>• Hoover &amp; State</li> <li>• State &amp; Packard</li> <li>• Eisenhower Pkwy &amp; Industrial</li> <li>• Hill &amp; State</li> <li>• Hill &amp; Main</li> <li>• Granger &amp; Packard</li> <li>• Hill &amp; Packard</li> <li>• Packard &amp; Wells</li> <li>• Pauline &amp; Main</li> <li>• Stadium Blvd &amp; Main</li> <li>• Hill &amp; Division</li> </ul> |

Source: URS Corporation, 2007.

**FIGURE 1**  
**INTERSECTION ANALYSIS**

| Stadium Blvd & Packard St            | AM Peak Traffic Period<br>7:00 A.M. – 8:00 A.M. | Existing<br>(Before) | Emergency Closure<br>(0-24 hours) | Short Term<br>(24 hours - 2 weeks) | Long Term<br>(2 weeks +) |
|--------------------------------------|-------------------------------------------------|----------------------|-----------------------------------|------------------------------------|--------------------------|
|                                      | Level of Service (LOS)                          | E                    | F                                 | F                                  | E                        |
|                                      | Average Control Delay (seconds/vehicle)         | 71.6                 | 413.6                             | 167.6                              | 75.3                     |
|                                      | EB Left Turn Queue (feet)                       | 132                  | 1641                              | 847                                | 573                      |
|                                      | <i>EB Left Turn Queue (vehicles)</i>            | 5                    | 66                                | 34                                 | 23                       |
|                                      | SB Thru Queue (feet)                            | 269                  | 524                               | 330                                | 434                      |
|                                      | <i>SB Thru Queue (vehicles)</i>                 | 11                   | 21                                | 13                                 | 17                       |
|                                      | PM Peak Traffic Period<br>4:00 P.M. – 5:00 P.M. | Existing<br>(Before) | Emergency Closure<br>(0-24 hours) | Short Term<br>(24 hours - 2 weeks) | Long Term<br>(2 weeks +) |
|                                      | Level of Service (LOS)                          | E                    | F                                 | F                                  | F                        |
|                                      | Average Control Delay (seconds/vehicle)         | 67.8                 | 380.4                             | 189.8                              | 114.1                    |
| EB Left Turn Queue (feet)            | 134                                             | 1702                 | 1018                              | 765                                |                          |
| <i>EB Left Turn Queue (vehicles)</i> | 5                                               | 68                   | 41                                | 31                                 |                          |
| SB Thru Queue (feet)                 | 1153                                            | 1992                 | 1285                              | 1207                               |                          |
| <i>SB Thru Queue (vehicles)</i>      | 46                                              | 80                   | 51                                | 48                                 |                          |

| Stadium Blvd & S Industrial           | AM Peak Traffic Period<br>7:00 A.M. – 8:00 A.M. | Existing<br>(Before) | Emergency Closure<br>(0-24 hours) | Short Term<br>(24 hours - 2 weeks) | Long Term<br>(2 weeks +) |
|---------------------------------------|-------------------------------------------------|----------------------|-----------------------------------|------------------------------------|--------------------------|
|                                       | Level of Service (LOS)                          | C                    | F                                 | C                                  | C                        |
|                                       | Average Control Delay (seconds/vehicle)         | 22.7                 | 137.9                             | 30.4                               | 30                       |
|                                       | WB Left Turn Queue (feet)                       | 217                  | 1273                              | 334                                | 334                      |
|                                       | <i>WB Left Turn Queue (vehicles)</i>            | 9                    | 51                                | 13                                 | 13                       |
|                                       | NB Right Turn Queue (feet)                      | 60                   | 676                               | 104                                | 104                      |
|                                       | <i>NB Right Turn Queue (vehicles)</i>           | 2                    | 27                                | 4                                  | 4                        |
|                                       | PM Peak Traffic Period<br>4:00 P.M. – 5:00 P.M. | Existing<br>(Before) | Emergency Closure<br>(0-24 hours) | Short Term<br>(24 hours - 2 weeks) | Long Term<br>(2 weeks +) |
|                                       | Level of Service (LOS)                          | C                    | F                                 | D                                  | D                        |
|                                       | Average Control Delay (seconds/vehicle)         | 33.9                 | 302.2                             | 39.9                               | 38.3                     |
| WB Left Turn Queue (feet)             | 342                                             | 1741                 | 705                               | 521                                |                          |
| <i>WB Left Turn Queue (vehicles)</i>  | 14                                              | 70                   | 28                                | 21                                 |                          |
| NB Right Turn Queue (feet)            | 101                                             | 1399                 | 136                               | 244                                |                          |
| <i>NB Right Turn Queue (vehicles)</i> | 4                                               | 56                   | 5                                 | 10                                 |                          |

| Stadium Blvd & Main St               | AM Peak Traffic Period<br>7:00 A.M. – 8:00 A.M. | Existing<br>(Before) | Emergency Closure<br>(0-24 hours) | Short Term<br>(24 hours - 2 weeks) | Long Term<br>(2 weeks +) |
|--------------------------------------|-------------------------------------------------|----------------------|-----------------------------------|------------------------------------|--------------------------|
|                                      | Level of Service (LOS)                          | F                    | E                                 | C                                  | C                        |
|                                      | Average Control Delay (seconds/vehicle)         | 108.6                | 72.9                              | 32.8                               | 30.8                     |
|                                      | EB Left Turn Queue (feet)                       | 116                  | 234                               | 153                                | 134                      |
|                                      | <i>EB Left Turn Queue (vehicles)</i>            | 5                    | 9                                 | 6                                  | 5                        |
|                                      | NB Left Turn Queue (feet)                       | 217                  | 890                               | 333                                | 274                      |
|                                      | <i>NB Left Turn Queue (vehicles)</i>            | 9                    | 36                                | 13                                 | 11                       |
|                                      | PM Peak Traffic Period<br>4:00 P.M. – 5:00 P.M. | Existing<br>(Before) | Emergency Closure<br>(0-24 hours) | Short Term<br>(24 hours - 2 weeks) | Long Term<br>(2 weeks +) |
|                                      | Level of Service (LOS)                          | E                    | F                                 | F                                  | D                        |
|                                      | Average Control Delay (seconds/vehicle)         | 76.2                 | 249.4                             | 89.3                               | 44.7                     |
| EB Left Turn Queue (feet)            | 54                                              | 257                  | 134                               | 166                                |                          |
| <i>EB Left Turn Queue (vehicles)</i> | 2                                               | 10                   | 5                                 | 7                                  |                          |
| NB Left Turn Queue (feet)            | 413                                             | 1646                 | 788                               | 706                                |                          |
| <i>NB Left Turn Queue (vehicles)</i> | 17                                              | 66                   | 32                                | 28                                 |                          |

Source: Synchro, URS Corporation, 2007.

Figure 2

COMPLETE SIGNALIZED INTERSECTION PM PEAK PERIOD ANALYSIS

| AM                                                                                                                  | East Stadium Boulevard Improvements Project Intersection | Existing (Ex.) |       |                 | Emergency Closure Plan |       |                 | Short Term (ST) |      |                 | % Change From Ex. | Long Term |      |                 | % Change From ST | % Change From Ex. |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------|-------|-----------------|------------------------|-------|-----------------|-----------------|------|-----------------|-------------------|-----------|------|-----------------|------------------|-------------------|--------------|--|--|--|--|--|--------------|--|--|--|--|--|----------------|--|--|---------------|--|--|
|                                                                                                                     |                                                          | Cycle          | LOS   | Delay (sec/veh) | Cycle                  | LOS   | Delay (sec/veh) | Cycle           | LOS  | Delay (sec/veh) |                   | Cycle     | LOS  | Delay (sec/veh) |                  |                   |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
| S<br>i<br>g<br>n<br>a<br>l<br>i<br>z<br>e<br>d<br><br>I<br>n<br>t<br>e<br>r<br>s<br>e<br>c<br>t<br>i<br>o<br>n<br>s | 1 Eisenhower Pkwy & State                                | 121.3          | C     | 34.0            | 129.5                  | F     | 87.1            | 107.7           | C    | 31.9            | -6.18%            | 111       | C    | 33.1            | 3.76%            | -2.65%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 3 WB I-94 & Ann Arbor-Saline                             | 126.2          | C     | 24.3            | 126.2                  | C     | 24.3            | 125.1           | C    | 24.0            | -1.23%            | 125.2     | C    | 24.0            | 0.00%            | -1.23%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 4 EB I-94 & Ann Arbor-Saline                             | 90             | A     | 8.8             | 90                     | A     | 8.8             | 90              | A    | 8.8             | 0.00%             | 90        | A    | 8.9             | 1.14%            | 1.14%             |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 6 Stadium Blvd & Packard                                 | 144.5          | E     | 71.6            | 150.9                  | F     | 413.6           | 129.8           | F    | 167.6           | 134.08%           | 140       | E    | 75.3            | -55.07%          | 5.17%             |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 7 Scio Church & Main                                     | 76.4           | B     | 15.4            | 120.2                  | C     | 25.8            | 88.4            | B    | 17.4            | 12.99%            | 100       | B    | 18.9            | 8.62%            | 22.73%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 9 Eisenhower Pkwy & Ann Arbor-Saline                     | 144            | C     | 24.1            | 144                    | C     | 24.1            | 144             | C    | 25.7            | 6.64%             | 144       | C    | 25.8            | 0.39%            | 7.05%             |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 10 Eisenhower Pkwy & Main                                | 81.1           | C     | 24.3            | 134.9                  | F     | 221.6           | 133.5           | E    | 62.2            | 155.97%           | 110.8     | C    | 33.4            | -46.30%          | 37.45%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 12 Main & Ann Arbor-Saline                               | 91.9           | B     | 17.1            | 109.3                  | F     | 159.2           | 96.7            | C    | 27.8            | 62.57%            | 100       | C    | 24.5            | -11.87%          | 43.27%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 15 Stimson & State                                       | 97.9           | C     | 23.0            | 77.4                   | C     | 27.3            | 56.1            | B    | 14.7            | -36.09%           | 54        | B    | 14.2            | -3.40%           | -38.26%           |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 16 Hoover & State                                        | 90             | B     | 10.6            | 90                     | C     | 23.8            | 90              | C    | 21.1            | 99.06%            | 55        | B    | 16.3            | -22.75%          | 53.77%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 17 Oakbrook & State                                      | 72             | A     | 6.6             | 72                     | A     | 7.6             | 72              | A    | 5.9             | -10.61%           | 72        | A    | 5.9             | 0.00%            | -10.61%           |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 18 State & Packard                                       | 90             | C     | 24.1            | 90                     | C     | 31.6            | 90              | C    | 20.8            | -13.69%           | 110       | C    | 22.0            | 5.77%            | -8.71%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 21 Briarwood Cir & State                                 | 73.1           | B     | 11.7            | 73.1                   | B     | 11.7            | 73.1            | B    | 13.3            | 13.68%            | 73.2      | B    | 13.2            | -0.75%           | 12.82%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 23 WB I-94 & NB State                                    | 72             | D     | 51.5            | 72                     | D     | 51.5            | 72              | D    | 37.7            | -26.80%           | 72        | D    | 37.7            | 0.00%            | -26.80%           |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 24 EB I-94 & State                                       | 72             | D     | 37.0            | 72                     | D     | 37.0            | 72              | C    | 29.3            | -20.81%           | 72        | C    | 29.3            | 0.00%            | -20.81%           |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 25 Eisenhower Pkwy & Boardwalk                           | 144            | A     | 9.9             | 144                    | A     | 9.6             | 144             | A    | 9.5             | -4.04%            | 144       | B    | 12.3            | 29.47%           | 24.24%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 27 Eisenhower Pkwy & Industrial                          | 144            | C     | 30.5            | 144                    | E     | 59.9            | 144             | D    | 50.7            | 66.23%            | 115.6     | D    | 42.1            | -16.96%          | 38.03%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 42 Hill & State                                          | 90             | C     | 21.7            | 90                     | B     | 15.9            | 90              | B    | 16.2            | -25.35%           | 110       | B    | 12.3            | -24.07%          | -43.32%           |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 44 Stadium Blvd & Park                                   | 85.5           | C     | 22.7            | 135.8                  | F     | 137.9           | 98.6            | C    | 30.4            | 33.92%            | 100.3     | C    | 30.0            | -1.32%           | 32.16%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 45 Hill & Main                                           | 90             | A     | 8.8             | 90                     | F     | 205.4           | 90              | C    | 32.1            | 264.77%           | 90        | B    | 14.5            | -54.83%          | 64.77%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 46 Packard & Main                                        | 90             | C     | 22.1            | 90                     | C     | 22.7            | 90              | C    | 23.5            | 6.33%             | 90        | C    | 24.2            | 2.98%            | 9.50%             |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 47 Granger & Packard                                     | 90             | B     | 15.6            | 90                     | F     | 185.5           | 90              | F    | 85.1            | 445.51%           | 140       | E    | 66.9            | -21.39%          | 328.85%           |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 50 Packard & Fifth                                       | 90             | B     | 16.9            | 90                     | B     | 16.8            | 90              | B    | 17.1            | 1.18%             | 90        | B    | 16.9            | -1.17%           | 0.00%             |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 57 Hill & Packard                                        | 90             | C     | 22.4            | 90                     | E     | 73.3            | 90              | C    | 26.5            | 18.30%            | 110       | C    | 21.4            | -19.25%          | -4.46%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 58 Stimson & E Park                                      | 49.7           | A     | 7.1             | 50                     | F     | 92.3            | 42.1            | A    | 9.8             | 38.03%            | 41.7      | A    | 9.9             | 1.02%            | 39.44%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 59 Packard & Wells                                       | 90             | A     | 8.3             | 90                     | F     | 119.6           | 90              | D    | 51.5            | 520.48%           | 140       | A    | 9.8             | -80.97%          | 18.07%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 73 Madison & Main                                        | 90             | B     | 11.1            | 90                     | B     | 13.0            | 90              | B    | 12.5            | 12.61%            | 90        | B    | 14.4            | 15.20%           | 29.73%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
|                                                                                                                     | 76 Madison & Division                                    | 90             | B     | 14.1            | 90                     | B     | 16.3            | 90              | B    | 15.5            | 9.93%             | 90        | B    | 16.0            | 3.23%            | 13.48%            |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
| 82 Packard & Fourth                                                                                                 | 90                                                       | B              | 13.7  | 90              | B                      | 13.7  | 90              | B               | 11.9 | -13.14%         | 90                | B         | 11.4 | -4.20%          | -16.79%          |                   |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
| 86 Pauline & Main                                                                                                   | 90                                                       | B              | 14.5  | 90              | D                      | 42.1  | 90              | B               | 14.9 | 2.76%           | 90                | B         | 15.0 | 0.67%           | 3.45%            |                   |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
| 88 Stadium Blvd & Main                                                                                              | 179.6                                                    | F              | 108.6 | 155.8           | E                      | 72.9  | 124.7           | C               | 32.8 | -69.80%         | 121.9             | C         | 30.8 | -6.10%          | -71.64%          |                   |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
| 93 Hill & Division                                                                                                  | 90                                                       | C              | 28.3  | 90              | F                      | 210.9 | 90              | D               | 37.3 | 31.80%          | 110               | B         | 14.3 | -61.66%         | -49.47%          |                   |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
| 98 Packard & Thompson                                                                                               | 90                                                       | A              | 4.5   | 90              | A                      | 4.0   | 90              | A               | 3.7  | -17.78%         | 90                | A         | 4.4  | 18.92%          | -2.22%           |                   |              |  |  |  |  |  |              |  |  |  |  |  |                |  |  |               |  |  |
| <b>Total Intersection Delay Time:</b>                                                                               |                                                          |                |       |                 | <b>764.9</b>           |       |                 |                 |      |                 | <b>2466.8</b>     |           |      |                 |                  |                   | <b>989.2</b> |  |  |  |  |  | <b>749.1</b> |  |  |  |  |  | <b>-24.27%</b> |  |  | <b>-2.07%</b> |  |  |

KEY

- Count 15 Signal Timing Modifications
- Intersections with Average Control Delay with LOS E or F
- No change in Average Control Delay between Traffic Scenarios
- % Increase in Average Control Delay between Traffic Scenarios
- % Decrease in Average Control Delay between Traffic Scenarios

Source: Synchro, URS Corporation, 2007.

**FIGURE 3**  
**COMPLETE SIGNALIZED INTERSECTION AM PEAK PERIOD ANALYSIS**

| PM                                                                                                                  | East Stadium Boulevard Improvements Project Intersection | Existing (Ex.) |      |                 | Emergency Closure Plan |       |                 | Short Term (ST) |      |                 | % Change From Ex. | Long Term |      |                 | % Change From ST | % Change From Ex. |
|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------|------|-----------------|------------------------|-------|-----------------|-----------------|------|-----------------|-------------------|-----------|------|-----------------|------------------|-------------------|
|                                                                                                                     |                                                          | Cycle          | LOS  | Delay (sec/veh) | Cycle                  | LOS   | Delay (sec/veh) | Cycle           | LOS  | Delay (sec/veh) |                   | Cycle     | LOS  | Delay (sec/veh) |                  |                   |
| S<br>i<br>g<br>n<br>a<br>l<br>i<br>z<br>e<br>d<br><br>I<br>n<br>t<br>e<br>r<br>s<br>e<br>c<br>t<br>i<br>o<br>n<br>s | 1 Eisenhower Pkwy & State                                | 130.5          | D    | 37.8            | 109                    | E     | 77.4            | 115             | D    | 38.1            | 0.79%             | 116.8     | D    | 39.6            | 3.94%            | 4.76%             |
|                                                                                                                     | 3 WB I-94 & Ann Arbor-Saline                             | 144            | D    | 38.7            | 144                    | D     | 38.7            | 144             | D    | 36.4            | -5.94%            | 144       | D    | 36.4            | 0.00%            | -5.94%            |
|                                                                                                                     | 4 EB I-94 & Ann Arbor-Saline                             | 90             | B    | 15.9            | 90                     | B     | 15.9            | 90              | B    | 14.1            | -11.32%           | 90        | B    | 14.1            | 0.00%            | -11.32%           |
|                                                                                                                     | 6 Stadium Blvd & Packard                                 | 155.5          | E    | 67.8            | 154.1                  | F     | 380.4           | 126.6           | F    | 189.8           | 179.94%           | 140       | F    | 103.2           | -45.63%          | 52.21%            |
|                                                                                                                     | 7 Scio Church & Main                                     | 124.4          | D    | 38.3            | 127.6                  | F     | 125.4           | 127.5           | D    | 51.4            | 34.20%            | 110       | C    | 30.4            | -40.86%          | -20.63%           |
|                                                                                                                     | 9 Eisenhower Pkwy & Ann Arbor-Saline                     | 144            | D    | 38.0            | 144                    | D     | 38.0            | 144             | D    | 39.8            | 4.74%             | 144       | D    | 39.5            | -0.75%           | 3.95%             |
|                                                                                                                     | 10 Eisenhower Pkwy & Main                                | 112.8          | D    | 35.7            | 141.5                  | F     | 378.8           | 140             | F    | 90.9            | 154.62%           | 110       | E    | 58.0            | -36.19%          | 62.46%            |
|                                                                                                                     | 12 Main & Ann Arbor-Saline                               | 99.3           | B    | 17.4            | 133.3                  | F     | 253.6           | 100.6           | E    | 69.2            | 297.70%           | 110       | C    | 25.5            | -63.15%          | 46.55%            |
|                                                                                                                     | 15 Stimson & State                                       | 101.3          | C    | 21.9            | 99.5                   | F     | 95.5            | 64.5            | B    | 16.6            | -24.20%           | 64.9      | B    | 16.6            | 0.00%            | -24.20%           |
|                                                                                                                     | 16 Hoover & State                                        | 90             | B    | 13.7            | 90                     | D     | 37.2            | 90              | B    | 19.8            | 44.53%            | 55        | B    | 15.9            | -19.70%          | 16.06%            |
|                                                                                                                     | 17 Oakbrook & State                                      | 72             | B    | 13.8            | 72                     | B     | 13.2            | 72              | B    | 12.5            | -9.42%            | 72        | B    | 12.5            | 0.00%            | -9.42%            |
|                                                                                                                     | 18 State & Packard                                       | 90             | C    | 34.0            | 90                     | F     | 89.8            | 90              | C    | 29.3            | -13.82%           | 110       | C    | 24.4            | -16.72%          | -28.24%           |
|                                                                                                                     | 21 Briarwood Cir & State                                 | 85.6           | C    | 27.4            | 85.6                   | C     | 27.4            | 85.4            | C    | 22.7            | -17.15%           | 85.4      | C    | 22.7            | 0.00%            | -17.15%           |
|                                                                                                                     | 23 WB I-94 & NB State                                    | 110            | C    | 28.6            | 110                    | C     | 28.6            | 110             | C    | 26.1            | -8.74%            | 110       | C    | 24.7            | -5.36%           | -13.64%           |
|                                                                                                                     | 24 EB I-94 & State                                       | 110            | C    | 29.9            | 110                    | C     | 29.9            | 110             | C    | 20.4            | -31.77%           | 110       | C    | 20.9            | 2.45%            | -30.10%           |
|                                                                                                                     | 25 Eisenhower Pkwy & Boardwalk                           | 144            | C    | 20.9            | 144                    | C     | 24.7            | 144             | C    | 23.6            | 12.92%            | 110       | C    | 23.9            | 1.27%            | 14.35%            |
|                                                                                                                     | 27 Eisenhower Pkwy & Industrial                          | 144            | D    | 40.3            | 144                    | F     | 187.9           | 144             | F    | 142.7           | 254.09%           | 145.9     | F    | 85.8            | -39.87%          | 112.90%           |
|                                                                                                                     | 42 Hill & State                                          | 90             | B    | 19.4            | 90                     | C     | 25.7            | 90              | C    | 23.2            | 19.59%            | 110       | B    | 15.6            | -32.76%          | -19.59%           |
|                                                                                                                     | 44 Stadium Blvd & Park                                   | 155.7          | C    | 33.9            | 143.7                  | F     | 302.2           | 115.7           | D    | 39.9            | 17.70%            | 99.1      | D    | 38.3            | -4.01%           | 12.98%            |
|                                                                                                                     | 45 Hill & Main                                           | 90             | B    | 18.7            | 90                     | F     | 287.2           | 90              | F    | 82.2            | 339.57%           | 110       | C    | 25.5            | -68.98%          | 36.36%            |
|                                                                                                                     | 46 Packard & Main                                        | 90             | B    | 18.3            | 90                     | B     | 18.1            | 90              | B    | 19.0            | 3.83%             | 90        | B    | 18.8            | -1.05%           | 2.73%             |
|                                                                                                                     | 47 Granger & Packard                                     | 90             | B    | 13.2            | 90                     | F     | 90.1            | 90              | C    | 22.8            | 72.73%            | 90        | C    | 26.8            | 17.54%           | 103.03%           |
|                                                                                                                     | 50 Packard & Fifth                                       | 90             | B    | 16.6            | 90                     | B     | 16.7            | 90              | B    | 16.6            | 0.00%             | 90        | B    | 16.0            | -3.61%           | -3.61%            |
|                                                                                                                     | 57 Hill & Packard                                        | 90             | C    | 25.2            | 90                     | F     | 340.5           | 90              | C    | 25.0            | -0.79%            | 110       | C    | 24.7            | -1.20%           | -1.98%            |
|                                                                                                                     | 58 Stimson & E Park                                      | 42.5           | A    | 8.4             | 50                     | F     | 151.2           | 42.5            | B    | 10.8            | 28.57%            | 43        | B    | 10.9            | 0.93%            | 29.76%            |
|                                                                                                                     | 59 Packard & Wells                                       | 90             | B    | 17.2            | 90                     | F     | 525.0           | 90              | F    | 401.4           | 2233.72%          | 150       | F    | 102.1           | -74.56%          | 493.60%           |
|                                                                                                                     | 73 Madison & Main                                        | 90             | C    | 24.6            | 90                     | C     | 22.2            | 90              | C    | 23.2            | -5.69%            | 90        | C    | 20.6            | -11.21%          | -16.26%           |
|                                                                                                                     | 76 Madison & Division                                    | 90             | B    | 13.5            | 90                     | B     | 14.9            | 90              | B    | 13.5            | 0.00%             | 90        | B    | 14.2            | 5.19%            | 5.19%             |
| 82 Packard & Fourth                                                                                                 | 90                                                       | A              | 9.8  | 90              | A                      | 9.8   | 90              | B               | 10.1 | 3.06%           | 90                | B         | 10.3 | 1.98%           | 5.10%            |                   |
| 86 Pauline & Main                                                                                                   | 90                                                       | A              | 6.1  | 90              | A                      | 7.6   | 90              | A               | 5.6  | -8.20%          | 55                | A         | 5.6  | 0.00%           | -8.20%           |                   |
| 88 Stadium Blvd & Main                                                                                              | 192                                                      | E              | 76.2 | 164.6           | F                      | 249.4 | 156.9           | F               | 89.3 | 17.19%          | 170               | D         | 44.7 | -49.94%         | -41.34%          |                   |
| 93 Hill & Division                                                                                                  | 90                                                       | C              | 23.0 | 90              | F                      | 228.2 | 90              | E               | 59.4 | 158.26%         | 110               | C         | 33.9 | -42.93%         | 47.39%           |                   |
| 98 Packard & Thompson                                                                                               | 90                                                       | C              | 31.0 | 90              | C                      | 29.2  | 90              | C               | 23.3 | -24.84%         | 90                | C         | 21.2 | -9.01%          | -31.61%          |                   |
| <b>Total Intersection Delay Time:</b>                                                                               |                                                          |                |      | <b>875.2</b>    |                        |       | <b>4160.4</b>   |                 |      | <b>1708.7</b>   | <b>95.24%</b>     |           |      | <b>1023.3</b>   | <b>-40.11%</b>   | <b>16.92%</b>     |

**KEY**

- Count 15 Signal Timing Modifications
- Intersections with Average Control Delay with LOS E or F
- No change in Average Control Delay between Traffic Scenarios
- % Increase in Average Control Delay between Traffic Scenarios
- % Decrease in Average Control Delay between Traffic Scenarios

Source: Synchro, URS Corporation, 2007.



Client: City of Ann Arbor  
Project Name: East Stadium Boulevard Bridge Replacement Project  
Location: City of Ann Arbor  
Project Number: 12940111  
Issue Date: October 19, 2009

**PROJECT  
MEMORANDUM**

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TO: **Mike Nearing, PE  
City of Ann Arbor**

FROM: **Matt Klawon, PE  
Luke Liu, Ph.D., PE, PTOE  
Jonathan Coleman, EIT**

SUBJECT: **East Stadium Boulevard Detour Traffic Rerouting**

**1.0 INTRODUCTION**

For all detour routes, the network is defined as all intersections included in the study area which is defined as Packard Street to the north, Industrial Highway to the east, I-94 to the south and Ann Arbor-Saline Road/Main Street to the west. Expected changes in traffic volumes on the network are composed of:

- 1) Out-of-network Detour - Which is traffic that would avoid the entire area affected by the construction.
- 2) Posted Detour - Which is traffic that would follow the posted detour route and travel through the network.
- 3) User-selected Detour - Which allows drivers, knowledgeable of the network, to navigate through the area affected by construction via their own detour (or alternate) routes other than the posted detour.

For all detour routes, traffic volumes were redistributed throughout the network based on existing traffic patterns and turning movement volumes at intersections. This memo first describes the methodology applied in the distribution of rerouting traffic and then presents the discussion of varying levels of traffic expected for each category of the detour.

**2.0 TRAFFIC REALLOCATION**

**2.1 Traffic Rerouting Methodology**

For the above three types of detours, the amount of traffic being redistributed was first applied to the two intersections on either side of the bridge and then distributed throughout the network, starting from the two intersections and by tracing the sources of traffic on each link until specific and logical entry or exit traffic-movement points is reached. At any given intersection, changes in traffic volumes on a departing approach was distributed to relevant turning movements that feed traffic into this departing approach. For instance, if the southbound traffic departing an intersection are composed of traffic from the westbound-to-southbound left turn movement and southbound thru movement, the amount of traffic reduced on the southbound departing approach would be distributed to the two turning movements.

The distribution of changes in traffic volumes was based on peak-hour turning movement counts. Although there are many factors affecting driver behavior in terms of choosing detour routes such as knowledge of the road network and perception of traffic conditions, many of these factors are difficult to quantify and may often change over time. Turning movement volume was selected for the purpose of traffic redistribution as it aggregates the behavior of individual drivers at each intersection.



## **2.2 Traffic Levels on Various Routes**

Detour route signing helps direct drivers along appropriate routes although drivers who are familiar with the roadway system may not follow the posted detour routes. Often times, detour routes are selected based upon the existing roadway characteristics that match those of the route being closed. Characteristics of the roadway such as physical load ratings, truck routes, bus routes, etc., often weigh in the selection of detour routes as these vehicles need to be provided with a carefully selected and signed detour route. Detour routes may not be the most advantageous routes for all drivers including the local motorist who is familiar with the road system which may result in a reduction in total traffic volumes entering the detour route as well as the study area; this is shown in the following examples:

### **2.2.1 Example 1- Broadway Bridge (Ann Arbor, Michigan)**

Analysis of traffic data collected by the University of Michigan before and during the reconstruction of the Broadway Bridge in 2003-2004, indicated that not all traffic that previously used the Broadway Bridge route used the posted detour route. The posted detour route for this project, which utilized Glen Avenue and the Maiden Lane Bridge in the northbound direction over the Huron River, resulted in an approximate 30% increase in traffic volumes associated with detoured traffic which normally used the Broadway Bridge. This was based upon traffic counts collected during the peak hours before the construction and while the detour was in place. Many of the typical vehicle trips do not occur as a result of local motorists' desire to avoid using congested detour routes, and their knowledge of alternate paths around the construction and posted detour routes.

### **2.2.2 Example 2- Gateway Project (Detroit, Michigan)**

URS recently performed a study in September 2009 which analyzed detour route traffic associated with the MDOT Gateway Construction project which had a complete closure of I-75 between Clark Street and I-96 in Detroit. The primary detour route was I-94; the secondary detour route was I-275 to I-696. Historical traffic detector data from while the detour was in place was compared to data after construction which indicated that approximately 15% of drivers used I-94 as a primary detour route and that approximately 10% of drivers used the secondary detour route. Data also showed that motorists also chose other arterials such as US-12 (Michigan Avenue) and M-85 (Fort Street) as a detour route into and out of downtown Detroit.

Two primary actions are anticipated based upon normal driver behavior: approaching the detour and driving the most efficient route or avoiding the detour altogether by rerouting at intersections further from the construction area and posted detour. Many local drivers will seek to avoid potential congestion delay whether or not those delays actually exist. Those trips that no longer enter the study area will be classified as canceled trips; the vehicles depart or never reach the network since they find an acceptable alternate route outside of the study area.

Available alternate routes both within and outside of the study area are depicted in **Table 1** on the next page. There are a sufficient amount of available alternate routes that knowledgeable local motorists may take in an effort to avoid additional delays and congestion associated with the construction. A reduction in the amount of traffic entering the study area should be applied to the traffic volumes used in the modeling of the construction staging. Since there are approximately 10 viable alternate paths around the construction zone, it is anticipated that a large reduction of local traffic that would typically enter the study area would divert to these alternate routes.

**TABLE 1  
 ALTERNATE DETOUR ROUTES  
 (for westbound Stadium Boulevard)**

|    | Detour Name            | Detour Route (except first line)                                                                                                                         | Distance<br>(miles) | Estimated<br>Travel<br>Time<br>(minutes) | VS. Open to Traffic                 |                                          |
|----|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------|-------------------------------------|------------------------------------------|
|    |                        |                                                                                                                                                          |                     |                                          | Change<br>in<br>Distance<br>(miles) | Change in<br>Travel<br>Time<br>(minutes) |
| 0  | <b>Open to Traffic</b> | - <b>Eastbound Stadium</b>                                                                                                                               | 7                   | 13                                       | 0                                   | 0                                        |
| 1  | Eisenhower             | - Southbound Main Street<br>- Eastbound Eisenhower Parkway<br>- Northbound Industrial Highway                                                            | 10                  | 24                                       | 3                                   | 11                                       |
| 2  | Stimson                | - Southbound Main Street<br>- Eastbound Eisenhower Parkway<br>- Northbound State Street<br>- Eastbound Stimson Street<br>- Northbound Industrial Highway | 9.6                 | 23                                       | 2.6                                 | 10                                       |
| 3  | Hill                   | - Northbound Main Street<br>- Eastbound Hill Street<br>- Southeast bound Packard Street                                                                  | 7.8                 | 17                                       | 0.8                                 | 4                                        |
| 4  | Hoover                 | - Northbound Main Street<br>- Eastbound Hoover Street<br>- Northbound State Street<br>- Southeast bound Packard Street                                   | 7.7                 | 17                                       | 0.7                                 | 4                                        |
| 5  | Pauline                | - Eastbound Pauline Street<br>- Northbound Main Street<br>- Eastbound Hill Street<br>- Southeast bound Packard Street                                    | 7.3                 | 16                                       | 0.3                                 | 3                                        |
| 6  | Liberty                | - Northeast bound Liberty Street<br>- Southbound Main Street<br>- Southeast bound Packard Street                                                         | 7.3                 | 15                                       | 0.3                                 | 2                                        |
| 7  | Washtenaw              | - Eastbound Jackson Avenue<br>- Eastbound Huron Street<br>- Southeast bound Washtenaw Avenue                                                             | 10.7                | 10                                       | 3.7                                 | -3                                       |
| 8  | I-94                   | - Eastbound I-94<br>- Northbound US-23<br>- Westbound Washtenaw Avenue                                                                                   | 10                  | 9                                        | 3                                   | -4                                       |
| 9  | Packard                | - Eastbound I-94<br>- Northbound State Street<br>- Eastbound Eisenhower Parkway<br>- Eastbound Packard Road<br>- Northbound Carpenter Street             | 9.6                 | 17                                       | 2.6                                 | 4                                        |
| 10 | Huron Parkway          | - Eastbound I-94<br>- Northeast bound Ann Arbor-Saline Road<br>- Eastbound Eisenhower Parkway<br>- Eastbound Packard Road<br>- Northbound Huron Parkway  | 9.2                 | 18                                       | 2.2                                 | 5                                        |

Source: URS Corporation, 2009  
<http://maps.google.com>, 2009

Based on traffic engineering experience with factual data from the previously mentioned detouring routing examples as well as the availability of other viable alternate routes within and outside the study area, the following traffic reallocation estimates have been derived:

Originally estimated traffic reallocation based upon engineering judgment:

- 60% trips use out-of-network detour (canceled within the network)
- 30% trips use the posted detour
- 10% trips use user-selected detour within study area

The originally estimated traffic reallocation percentages should be modified to provide a more conservative estimate of traffic that will enter the study area. In general, the development of a conservative estimate infers that the traffic entering the study is comprised of fewer knowledgeable local motorists and that the reliance on the detour route would be increased slightly as well as the number of trips entering the study area and seeking alternate routes closer to the construction area. The conservative values, as shown below, indicate a minor increase to the traffic on the detour route and a marginal increase to those on alternate routes in the study area.

Conservative traffic reallocation estimates for purposes of developing mitigation measures:

- 40% trips use out-of-network detour (canceled within the network)
- 40% trips use the posted detour
- 20% trips use user-selected detour within study area

Another factor to consider is that drivers will adjust their own preferred routes based on acceptable levels of delay that they may encounter. Those local drivers seeking preferred routes will likely remain dynamic in the early stages of construction as they identify and select a preferred route that suits their needs.

**2.3 Traffic Volume Adjustment**

**Northbound State Street Closure**

The northbound traffic which previously approached the closure point on State Street will be rerouted as shown in the following table:

| <b>Detour Type</b>                        | <b>Description</b>                                                                                                                                       | <b>% of Traffic Diverted</b> |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Posted Detour to State Street             | <ul style="list-style-type: none"> <li>▪ Stimpson Street</li> <li>▪ Industrial Highway</li> <li>▪ Stadium Boulevard</li> <li>▪ Packard Street</li> </ul> | 40%                          |
| User-Selected Detour to North Campus      | <ul style="list-style-type: none"> <li>▪ Eisenhower Parkway</li> <li>▪ Main Street</li> <li>▪ Various Destinations</li> </ul>                            | 10%                          |
| User-Selected Detour by-pass State Street | <ul style="list-style-type: none"> <li>▪ Eisenhower Parkway</li> <li>▪ Industrial Highway</li> <li>▪ Various Destinations</li> </ul>                     | 10%                          |

**Southbound State Street Closure**

The southbound traffic which previously approached the closure point on State Street will be rerouted as shown in the following table:

| <b>Detour Type</b>                         | <b>Description</b>                                                                                                            | <b>% of Traffic Diverted</b> |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Posted Detour to State Street              | <ul style="list-style-type: none"> <li>▪ Hill Street</li> <li>▪ Main Street</li> <li>▪ Eisenhower Parkway</li> </ul>          | 40%                          |
| User-Selected Detour to Stadium Boulevard  | <ul style="list-style-type: none"> <li>▪ Packard Street</li> <li>▪ Stadium Boulevard</li> </ul>                               | 10%                          |
| User-Selected Detour to Industrial Highway | <ul style="list-style-type: none"> <li>▪ Packard Street</li> <li>▪ Stadium Boulevard</li> <li>▪ Industrial Highway</li> </ul> | 10%                          |

**Westbound Stadium Boulevard Closure**

The westbound traffic which previously approached the closure point on Stadium Boulevard will be rerouted as shown in the following table:

| <b>Detour Type</b>                        | <b>Description</b>                                                                                                          | <b>% of Traffic Diverted</b> |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Posted Detour to Stadium Boulevard        | <ul style="list-style-type: none"> <li>▪ Industrial Highway</li> <li>▪ Eisenhower Parkway</li> <li>▪ Main Street</li> </ul> | 40%                          |
| User-Selected Detour to Stadium Boulevard | <ul style="list-style-type: none"> <li>▪ Packard Street</li> <li>▪ Hill Street</li> <li>▪ Main Street</li> </ul>            | 20%                          |

**Eastbound Stadium Boulevard Closure**

The eastbound traffic which previously approached the closure point on Stadium Boulevard will be rerouted as shown in the following table:

| <b>Detour Type</b>                        | <b>Description</b>                                                                                                          | <b>% of Traffic Diverted</b> |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Posted Detour to Stadium Boulevard        | <ul style="list-style-type: none"> <li>▪ Main Street</li> <li>▪ Eisenhower Parkway</li> <li>▪ Industrial Highway</li> </ul> | 40%                          |
| User-Selected Detour to Stadium Boulevard | <ul style="list-style-type: none"> <li>▪ Main Street</li> <li>▪ Hill Street</li> <li>▪ Packard Street</li> </ul>            | 20%                          |

**3.0 CONCLUSION**

For purposes of mitigating the impacts of the construction staging and detouring within the study area intersections, conservative traffic reallocation percentages will be applied to the final traffic models. The models and intersections will then be evaluated for necessary mitigation measures to be implemented prior to construction, in an effort to optimize the traffic flow within the study area. Since conservative traffic volumes will be used in developing these mitigation measures, the roadway system should be more readily adaptable to reduced traffic volumes, if the conservative traffic volumes as estimated in this study are not realized.



Client: City of Ann Arbor  
Project Name: East Stadium Boulevard Bridge Replacement Project  
Location: City of Ann Arbor  
Project Number: 12940111  
Issue Date: November 4, 2009

**PROJECT  
MEMORANDUM**

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TO: **Mike Nearing, PE  
City of Ann Arbor**

FROM: **Matt Klawon, PE**

SUBJECT: **East Stadium Boulevard Detour Route Evaluation -- DRAFT**

**1.0 INTRODUCTION**

This memorandum summarizes the results of the Model 6 and Model 7 volume redistributions. It also discusses various measures implemented to potentially mitigate the impacts of the volume redistribution at various study intersections.

**2.0 VOLUME REDISTRIBUTION DESCRIPTIONS**

Conservative traffic reallocation estimates were applied to the traffic entering the study area. These traffic reallocation estimates, as described in the East Stadium Boulevard Detour Traffic Rerouting memo dated October 19, 2009, were applied to the study area traffic. The detours analyzed are the Model 6 and Model 7 detours. Model 6 presents a conservative volume reduction with eastbound and westbound E Stadium Blvd closed over S State St. S State St remains open to traffic in the Model 6 analysis. Model 7 presents a conservative volume reduction with eastbound and westbound E Stadium Blvd closed over S State St and northbound and southbound S State St closed under E Stadium Blvd. Access to various businesses, residences, and parking lots within the study area were maintained in both the Model 6 and Model 7 analysis.

**3.0 MODEL 6 VOLUME REDISTRIBUTION**

The Model 6 volume redistribution values were applied to the existing turning movement count volumes collected in the fall of 2007. The newly redistributed traffic volumes were then analyzed under the existing signal timings. The study area intersections were then evaluated to determine if any mitigation measures were necessary to improve traffic operations during the E Stadium Blvd closure. Mitigation measures, which include adding left-turn phases and optimizing intersection splits, were applied to intersections along the detour routes, with particular emphasis on intersections with major turning movements (i.e. the intersection of Packard St & Hill St). A comparison of the Model 6 study area intersection operations under existing signal timings and with mitigation measures is presented in **Table 1**.

**TABLE 1**  
**MODEL 6 VOLUME REDISTRIBUTION LOS AND DELAY**  
**EB & WB E STADIUM BLVD CLOSED**

| Location                              | Model 6 (EB & WB E Stadium Blvd Closed) Volume Redistribution |                 |     |                 |                          |                 |     |                 |
|---------------------------------------|---------------------------------------------------------------|-----------------|-----|-----------------|--------------------------|-----------------|-----|-----------------|
|                                       | With Existing Signal Timings                                  |                 |     |                 | With Mitigation Measures |                 |     |                 |
|                                       | AM                                                            |                 | PM  |                 | AM                       |                 | PM  |                 |
|                                       | LOS                                                           | Delay (Sec/veh) | LOS | Delay (Sec/veh) | LOS                      | Delay (Sec/veh) | LOS | Delay (Sec/veh) |
| Eisenhower Pkwy & S State St          | D                                                             | 44.1            | E   | 57.7            | D                        | 42.1            | D   | 46.8            |
| WB I-94 Ramp & Ann Arbor-Saline Rd    | C                                                             | 24.1            | D   | 36.3            | C                        | 24.1            | D   | 36.3            |
| EB I-94 Ramp & Ann Arbor-Saline Rd    | A                                                             | 8.9             | B   | 14.6            | A                        | 8.9             | B   | 14.6            |
| E Stadium Blvd & Packard St           | D                                                             | 49.0            | E   | 70.3            | D                        | 49.0            | E   | 64.4            |
| Scio Church Rd & S Main St            | B                                                             | 16.7            | D   | 39.8            | B                        | 18.3            | D   | 36.5            |
| Eisenhower Pkwy & Ann Arbor-Saline Rd | C                                                             | 24.4            | D   | 38.6            | C                        | 24.4            | D   | 38.6            |
| Eisenhower Pkwy & S Main St           | D                                                             | 48.2            | E   | 65.5            | C                        | 30.8            | E   | 55.3            |
| S Main St & Ann Arbor-Saline Rd       | C                                                             | 28.3            | D   | 50.2            | C                        | 29.3            | C   | 26.8            |
| Stimson St & S State St               | C                                                             | 23.2            | C   | 24.6            | C                        | 23.2            | C   | 24.6            |
| E Hoover Ave & S State St             | B                                                             | 10.7            | B   | 13.9            | B                        | 10.2            | B   | 10.7            |
| Oakbrook Dr & S State St              | A                                                             | 6.6             | B   | 13.5            | A                        | 6.6             | B   | 13.5            |
| S State St & Packard St               | C                                                             | 26.5            | F   | 109.2           | C                        | 27.5            | F   | 108.4           |
| Briarwood Cr & S State St             | B                                                             | 11.8            | C   | 26.4            | B                        | 11.8            | C   | 26.4            |
| WB I-94 Ramp & S State St             | D                                                             | 48.8            | C   | 27.4            | D                        | 48.8            | C   | 27.4            |
| EB I-94 Ramp & S State St             | D                                                             | 36.0            | C   | 30.1            | D                        | 36.0            | C   | 30.1            |
| Eisenhower Pkwy & Boardwalk Dr        | B                                                             | 10.6            | C   | 24.4            | B                        | 12.7            | C   | 24.3            |
| Eisenhower Pkwy & S Industrial Hwy    | D                                                             | 40.1            | F   | 183.8           | D                        | 35.1            | F   | 127.0           |
| Hill St & S State St                  | C                                                             | 20.4            | C   | 21.2            | C                        | 22.2            | B   | 16.4            |
| E Stadium Blvd & E Park Pl            | C                                                             | 25.7            | C   | 30.9            | C                        | 26.0            | C   | 30.6            |
| Hill St & S Main St                   | B                                                             | 13.6            | F   | 105.7           | B                        | 17.3            | C   | 33.5            |
| Packard St & S Main St                | C                                                             | 25.3            | B   | 19.7            | B                        | 15.6            | B   | 19.0            |
| Granger Ave & Packard St              | B                                                             | 15.1            | B   | 14.1            | B                        | 15.2            | B   | 13.1            |
| S 5 <sup>th</sup> Ave & Packard St    | B                                                             | 17.1            | B   | 16.2            | B                        | 13.2            | B   | 14.2            |
| Hill St & Packard St                  | C                                                             | 31.3            | F   | 399.1           | C                        | 29.9            | F   | 139.5           |
| Stimson St & E Park Pl                | A                                                             | 5.6             | A   | 8.3             | A                        | 5.6             | A   | 8.3             |
| Packard St & Wells St                 | A                                                             | 6.7             | F   | 316.1           | B                        | 10.4            | F   | 130.1           |
| E Madison St & S Main St              | B                                                             | 14.2            | C   | 21.2            | B                        | 12.8            | B   | 17.2            |
| E Madison St & S Division St          | B                                                             | 14.4            | B   | 14.4            | B                        | 14.9            | B   | 16.0            |
| Packard St & S 4 <sup>th</sup> Ave    | B                                                             | 12.9            | A   | 9.9             | A                        | 7.9             | A   | 9.6             |
| Pauline Blvd & S State St             | B                                                             | 14.6            | A   | 5.7             | B                        | 15.3            | A   | 6.5             |
| E Stadium Blvd & S Main St            | D                                                             | 35.8            | E   | 79.9            | C                        | 34.0            | F   | 80.5            |
| Hill St & S Division St               | C                                                             | 28.3            | F   | 101.5           | C                        | 27.5            | F   | 100.2           |
| Packard St & Thompson St              | A                                                             | 4.6             | C   | 29.7            | A                        | 3.7             | B   | 19.9            |

**4.0 MODEL 7 VOLUME REDISTRIBUTION**

The Model 7 volume redistribution values were applied to the existing turning movement count volumes collected in the fall of 2007. The newly redistributed traffic volumes were then analyzed under the existing signal timings. The study area

intersections were then evaluated to determine if any mitigation measures were necessary to improve traffic operations during the E Stadium Blvd and S State St closures. Mitigation measures, which include adding left-turn phases and optimizing intersection splits, were applied to intersections along the detour routes, with particular emphasis on intersections with major turning movements (i.e. the intersection of Packard St & Hill St). A comparison of the Model 7 study area intersection operations under existing signal timings and with mitigation measures is presented in **Table 2**.

**TABLE 2**  
**MODEL 7 VOLUME REDISTRIBUTION LOS AND DELAY**  
**EB & WB E STADIUM BLVD AND NB & SB S STATE ST CLOSED**

| Location                              | Model 7 (EB & WB E Stadium Blvd and NB & SB S State St Closed) Volume Redistribution |                 |     |                 |                          |                 |     |                 |
|---------------------------------------|--------------------------------------------------------------------------------------|-----------------|-----|-----------------|--------------------------|-----------------|-----|-----------------|
|                                       | With Existing Signal Timings                                                         |                 |     |                 | With Mitigation Measures |                 |     |                 |
|                                       | AM                                                                                   |                 | PM  |                 | AM                       |                 | PM  |                 |
|                                       | LOS                                                                                  | Delay (sec/veh) | LOS | Delay (sec/veh) | LOS                      | Delay (sec/veh) | LOS | Delay (sec/veh) |
| Eisenhower Pkwy & S State St          | D                                                                                    | 35.4            | C   | 33.2            | D                        | 36.1            | C   | 34.5            |
| WB I-94 Ramp & Ann Arbor-Saline Rd    | C                                                                                    | 24.7            | D   | 36.6            | C                        | 24.7            | D   | 36.6            |
| EB I-94 Ramp & Ann Arbor-Saline Rd    | A                                                                                    | 8.9             | B   | 14.5            | A                        | 8.9             | B   | 14.5            |
| E Stadium Blvd & Packard St           | F                                                                                    | 232.4           | F   | 245.4           | F                        | 95.0            | F   | 122.8           |
| Scio Church Rd & S Main St            | B                                                                                    | 19.7            | E   | 58.5            | C                        | 22.8            | D   | 54.2            |
| Eisenhower Pkwy & Ann Arbor-Saline Rd | C                                                                                    | 23.8            | D   | 38.2            | C                        | 23.8            | D   | 38.2            |
| Eisenhower Pkwy & S Main St           | F                                                                                    | 96.1            | F   | 117.4           | D                        | 41.7            | F   | 88.2            |
| S Main St & Ann Arbor-Saline Rd       | E                                                                                    | 55.4            | F   | 105.5           | C                        | 32.3            | C   | 30.8            |
| Stimson St & S State St               | A                                                                                    | 8.8             | A   | 9.2             | A                        | 8.8             | A   | 9.2             |
| E Hoover Ave & S State St             | B                                                                                    | 15.1            | B   | 17.6            | B                        | 13.7            | C   | 21.2            |
| Oakbrook Dr & S State St              | A                                                                                    | 6.3             | B   | 12.1            | A                        | 6.3             | B   | 12.1            |
| S State St & Packard St               | C                                                                                    | 20.7            | E   | 63.3            | C                        | 20.2            | E   | 60.9            |
| Briarwood Cr & S State St             | B                                                                                    | 13.0            | C   | 22.7            | B                        | 13.0            | C   | 22.7            |
| WB I-94 Ramp & S State St             | D                                                                                    | 38.3            | C   | 26.2            | D                        | 38.3            | C   | 26.2            |
| EB I-94 Ramp & S State St             | C                                                                                    | 29.5            | C   | 20.4            | C                        | 29.5            | C   | 20.4            |
| Eisenhower Pkwy & Boardwalk Dr        | A                                                                                    | 9.6             | C   | 26.7            | A                        | 9.5             | C   | 26.6            |
| Eisenhower Pkwy & S Industrial Hwy    | E                                                                                    | 64.0            | F   | 202.7           | D                        | 45.0            | F   | 135.7           |
| Hill St & S State St                  | B                                                                                    | 14.5            | C   | 22.3            | B                        | 11.4            | B   | 17.5            |
| E Stadium Blvd & E Park Pl            | C                                                                                    | 29.1            | D   | 40.5            | C                        | 29.5            | D   | 38.0            |
| Hill St & S Main St                   | C                                                                                    | 29.4            | E   | 78.5            | B                        | 18.9            | C   | 22.2            |
| Packard St & S Main St                | C                                                                                    | 33.3            | C   | 20.3            | B                        | 15.6            | B   | 18.0            |
| Granger Ave & Packard St              | E                                                                                    | 68.8            | C   | 22.3            | D                        | 48.6            | B   | 19.9            |
| S 5 <sup>th</sup> Ave & Packard St    | B                                                                                    | 17.2            | B   | 16.7            | B                        | 15.2            | B   | 14.7            |
| Hill St & Packard St                  | D                                                                                    | 37.7            | F   | 151.0           | B                        | 14.2            | E   | 70.8            |
| Stimson St & E Park Pl                | B                                                                                    | 12.3            | B   | 17.9            | B                        | 11.9            | B   | 17.9            |
| Packard St & Wells St                 | D                                                                                    | 45.9            | F   | 368.7           | A                        | 10.0            | F   | 309.1           |
| E Madison St & S Main St              | B                                                                                    | 14.6            | C   | 22.0            | B                        | 12.2            | B   | 17.6            |
| E Madison St & S Division St          | B                                                                                    | 15.6            | B   | 13.9            | C                        | 21.9            | B   | 14.3            |
| Packard St & S 4 <sup>th</sup> Ave    | B                                                                                    | 12.1            | B   | 11.8            | A                        | 9.3             | B   | 12.5            |
| Pauline Blvd & S State St             | B                                                                                    | 16.1            | A   | 6.7             | B                        | 17.0            | A   | 6.9             |
| E Stadium Blvd & S Main St            | D                                                                                    | 37.2            | F   | 129.0           | D                        | 35.3            | E   | 74.8            |
| Hill St & S Division St               | D                                                                                    | 43.9            | E   | 62.8            | D                        | 46.7            | C   | 24.6            |
| Packard St & Thompson St              | A                                                                                    | 4.1             | C   | 25.2            | A                        | 5.4             | B   | 18.7            |

## **5.0 CONCLUSIONS**

After redistributing the traffic volumes based on the conservative traffic reallocation estimates, the following measures are recommended to potentially mitigate the impacts of the traffic redistribution resulting from the closure of both E Stadium Blvd and S State St:

- *E Stadium Blvd & S Main St:*
  - Convert the eastbound shared thru-right turn lane to a right-turn only lane
  - Install an eastbound right turn green arrow traffic signal to overlap with the northbound left turn only signal phase
- *E Stadium Blvd & E Park Pl*
  - Convert the inner northbound dual left-turn only lane to a right-turn only lane (further investigation of turning radius required)
- *Packard St & Hill St*
  - Install a northwestbound flashing yellow arrow left-turn traffic signal
- *Various Intersections*
  - Optimize intersection splits based on new approach volumes
  - Adjust intersection offsets based on new approach volumes

All recommendations are based on the signal timing permits provided to URS by the city in 2007 and are subject to change based on any traffic signal equipment or operational modifications made in the ensuing years.



## Summary of Mitigation Measures by Roadway Closures and Peak Periods

| Intersection Node Number / Name | EB and WB Closure (Model 6)                                                                                                                                                                                                                                                                                                                                                              | EB and WB Closure (Model 6)                                                                                                                                                                                                                                                                                                                                                                                                             | NB/SB/EB/WB Closure (Model 7)                                                                                                                                                                                                                                                                                                                                                            | NB/SB/EB/WB Closure (Model 7)                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 | AM                                                                                                                                                                                                                                                                                                                                                                                       | PM                                                                                                                                                                                                                                                                                                                                                                                                                                      | AM                                                                                                                                                                                                                                                                                                                                                                                       | PM                                                                                                                                                                                                                                                                                                                                                                                       |
| #88, Stadium/Main               | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                                |
| #44, Stadium/Industrial         | <ul style="list-style-type: none"> <li>NB approach from (2 left + 1 shared thru/right) to (1 left + 1 thru + 1 right). This change is not reflected in the mitigated models because the receiving lane for NBT traffic is not modeled.</li> <li>Provide RTGA on NB approach</li> <li>Recall mode changed from EBT/WBT/NBL to WBL/NBR as this movement is part of detour route</li> </ul> | <ul style="list-style-type: none"> <li>NB approach from (2 left + 1 shared thru/right) to (1 left + 1 thru + 1 right). This change is not reflected in the mitigated models because the receiving lane for NBT traffic is not modeled.</li> <li>Provide RTGA on NB approach</li> <li>Recall mode changed from EBT/WBT/NBL to WBL/NBR as this movement is part of detour route</li> </ul>                                                | <ul style="list-style-type: none"> <li>NB approach from (2 left + 1 shared thru/right) to (1 left + 1 thru + 1 right). This change is not reflected in the mitigated models because the receiving lane for NBT traffic is not modeled.</li> <li>Provide RTGA on NB approach</li> <li>Recall mode changed from EBT/WBT/NBL to WBL/NBR as this movement is part of detour route</li> </ul> | <ul style="list-style-type: none"> <li>NB approach from (2 left + 1 shared thru/right) to (1 left + 1 thru + 1 right). This change is not reflected in the mitigated models because the receiving lane for NBT traffic is not modeled.</li> <li>Provide RTGA on NB approach</li> <li>Recall mode changed from EBT/WBT/NBL to WBL/NBR as this movement is part of detour route</li> </ul> |
| #15, Stimson/State              | <ul style="list-style-type: none"> <li>--</li> </ul>                                                                                                                                                                                                                                                                                                                                     | <ul style="list-style-type: none"> <li>--</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Overlap NBR with WBL</li> <li>Recall mode changed from NB/SB to WBL</li> </ul>                                                                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Overlap NBR with WBL</li> <li>Recall mode changed from NB/SB to WBL</li> </ul>                                                                                                                                                                                                                                                                    |
| #6, Stadium/Packard             | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                                |
| #10, Eisenhower/Main            | <ul style="list-style-type: none"> <li>Utilize Michigan left turn for left turn traffic from Main to Eisenhower</li> <li>Install signal at the crossover on Eisenhower west of Main</li> <li>Remove split phasing on Main</li> <li>SB Main approach from (1 left + 1 thru + 1 shared thru/right) to (1 thru/right + 1 right)</li> </ul>                                                  | <ul style="list-style-type: none"> <li>Utilize Michigan left turn for left turn traffic from Main to Eisenhower</li> <li>Install signal at the crossover on Eisenhower west of Main</li> <li>Remove split phasing on Main</li> <li>SB Main approach from (1 left + 1 thru + 1 shared thru/right) to (1 thru/right + 1 right)</li> <li>NB Main approach from (1 shared left/thru + 1 shared thru/right) to (1 thru + 1 right)</li> </ul> | <ul style="list-style-type: none"> <li>Utilize Michigan left turn for left turn traffic from NB Main to WB Eisenhower</li> <li>Remove split phasing on Main</li> <li>SB Main approach from (1 left + 1 thru + 1 shared thru/right) to (2 left + 1 shared thru/right)</li> </ul>                                                                                                          | <ul style="list-style-type: none"> <li>Utilize Michigan left turn for left turn traffic from NB Main to WB Eisenhower</li> <li>Remove split phasing on Main</li> <li>SB Main approach from (1 left + 1 thru + 1 shared thru/right) to (2 left + 1 shared thru/right)</li> <li>Consider installing temporary traffic signal at the crossover on Eisenhower east of Main.</li> </ul>       |
| #27, Eisenhower/Industrial      | <ul style="list-style-type: none"> <li>SB approach from (1 left + 1 shared thru/right) to (1 shared left/thru + 2 right)</li> <li>Apply split phasing on Industrial approaches</li> </ul>                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>SB approach from (1 left + 1 shared thru/right) to (1 shared left/thru + 2 right)</li> <li>Apply split phasing on Industrial approaches</li> </ul>                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>SB approach from (1 left + 1 shared thru/right) to (1 shared left/thru + 2 right)</li> <li>Apply split phasing on Industrial approaches</li> </ul>                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>SB approach from (1 left + 1 shared thru/right) to (1 shared left/thru + 2 right)</li> <li>Apply split phasing on Industrial approaches</li> </ul>                                                                                                                                                                                                |

|                    |                                                                   |                                                                                                                                                                                       |                                                                   |                                                                                                                                                                                       |
|--------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #57, Hill/Packard  | <ul style="list-style-type: none"> <li>• --</li> </ul>            | <ul style="list-style-type: none"> <li>• SB Packard approach from (left + shared T/R) to (shared L/T + shared T/R).</li> <li>• Add left turn phase to NB Packard left turn</li> </ul> | <ul style="list-style-type: none"> <li>• --</li> </ul>            | <ul style="list-style-type: none"> <li>• SB Packard approach from (left + shared T/R) to (shared L/T + shared T/R).</li> <li>• Add left turn phase to NB Packard left turn</li> </ul> |
| #93, Hill/Division | <ul style="list-style-type: none"> <li>• Add EBL phase</li> </ul> | <ul style="list-style-type: none"> <li>• Add EBL phase</li> </ul>                                                                                                                     | <ul style="list-style-type: none"> <li>• Add EBL phase</li> </ul> | <ul style="list-style-type: none"> <li>• Add EBL phase</li> </ul>                                                                                                                     |
| #18, State/Packard | <ul style="list-style-type: none"> <li>• --</li> </ul>            | <ul style="list-style-type: none"> <li>• SB State approach from (1 left + 1 shared thru/right) to (1 left + 1 thru + 1 right)</li> <li>•</li> </ul>                                   | <ul style="list-style-type: none"> <li>• --</li> </ul>            | <ul style="list-style-type: none"> <li>• SB State approach from (1 left + 1 shared thru/right) to (1 left + 1 thru + 1 right)</li> <li>•</li> </ul>                                   |

**TABLE 1**  
**MODEL 6 VOLUME REDISTRIBUTION LOS AND DELAY**  
**EB & WB E STADIUM BLVD CLOSED**

| Location                              | Model 6 (EB & WB E Stadium Blvd Closed) Volume Redistribution |                 |     |                 |                          |                 |     |                 |
|---------------------------------------|---------------------------------------------------------------|-----------------|-----|-----------------|--------------------------|-----------------|-----|-----------------|
|                                       | With Existing Signal Timings                                  |                 |     |                 | With Mitigation Measures |                 |     |                 |
|                                       | AM                                                            |                 | PM  |                 | AM                       |                 | PM  |                 |
|                                       | LOS                                                           | Delay (Sec/veh) | LOS | Delay (Sec/veh) | LOS                      | Delay (Sec/veh) | LOS | Delay (Sec/veh) |
| Eisenhower Pkwy & S State St          | D                                                             | 44.1            | E   | 58.0            | D                        | 40.8            | D   | 45.9            |
| WB I-94 Ramp & Ann Arbor-Saline Rd    | C                                                             | 24.1            | D   | 36.7            | C                        | 24.1            | D   | 36.7            |
| EB I-94 Ramp & Ann Arbor-Saline Rd    | A                                                             | 8.9             | B   | 14.5            | A                        | 8.9             | B   | 14.5            |
| E Stadium Blvd & Packard St           | D                                                             | 48.6            | E   | 65.0            | D                        | 39.5            | D   | 45.8            |
| Scio Church Rd & S Main St            | B                                                             | 16.7            | D   | 39.9            | B                        | 17.8            | C   | 31.5            |
| Eisenhower Pkwy & Ann Arbor-Saline Rd | C                                                             | 27.6            | D   | 40.5            | C                        | 27.5            | D   | 40.5            |
| Eisenhower Pkwy & S Main St           | D                                                             | 43.2            | E   | 58.5            | B                        | 19.4            | C   | 26.0            |
| S Main St & Ann Arbor-Saline Rd       | C                                                             | 23.2            | D   | 42.2            | C                        | 22.8            | C   | 21.2            |
| Stimson St & S State St               | C                                                             | 23.2            | C   | 25.1            | C                        | 22.7            | C   | 23.9            |
| E Hoover Ave & S State St             | B                                                             | 10.7            | B   | 13.8            | A                        | 9.3             | B   | 13.6            |
| Oakbrook Dr & S State St              | A                                                             | 6.6             | B   | 13.6            | A                        | 6.6             | B   | 13.6            |
| S State St & Packard St               | C                                                             | 26.0            | D   | 54.9            | C                        | 24.2            | D   | 52.3            |
| Briarwood Cr & S State St             | B                                                             | 11.8            | C   | 26.6            | B                        | 11.8            | C   | 26.6            |
| WB I-94 Ramp & S State St             | D                                                             | 48.8            | C   | 27.4            | D                        | 48.8            | C   | 27.4            |
| EB I-94 Ramp & S State St             | D                                                             | 36.0            | C   | 30.5            | D                        | 36.0            | C   | 30.5            |
| Eisenhower Pkwy & Boardwalk Dr        | A                                                             | 9.6             | C   | 24.4            | B                        | 13.2            | C   | 27.2            |
| Eisenhower Pkwy & S Industrial Hwy    | D                                                             | 54.4            | F   | 185.5           | D                        | 36.5            | D   | 49.5            |
| Hill St & S State St                  | C                                                             | 20.6            | C   | 21.0            | B                        | 17.7            | B   | 17.5            |
| E Stadium Blvd & E Park Pl            | C                                                             | 25.7            | C   | 31.7            | B                        | 12.2            | B   | 12.6            |
| Hill St & S Main St                   | B                                                             | 14.1            | D   | 49.9            | B                        | 10.0            | C   | 21.2            |
| Packard St & S Main St                | C                                                             | 26.6            | C   | 22.4            | B                        | 18.1            | C   | 21.8            |
| Granger Ave & Packard St              | B                                                             | 15.1            | B   | 12.7            | B                        | 15.6            | B   | 12.7            |
| S 5 <sup>th</sup> Ave & Packard St    | B                                                             | 17.1            | B   | 16.5            | B                        | 16.7            | B   | 16.7            |
| Hill St & Packard St                  | C                                                             | 27.8            | F   | 125.6           | B                        | 18.4            | C   | 28.7            |
| Stimson St & E Park Pl                | A                                                             | 5.6             | A   | 8.5             | A                        | 5.7             | A   | 8.2             |
| Packard St & Wells St                 | A                                                             | 6.7             | C   | 20.2            | A                        | 6.4             | C   | 20.3            |
| E Madison St & S Main St              | B                                                             | 14.1            | C   | 22.6            | B                        | 13.9            | C   | 21.8            |
| E Madison St & S Division St          | B                                                             | 15.4            | B   | 15.0            | B                        | 16.9            | B   | 17.9            |
| Packard St & S 4 <sup>th</sup> Ave    | B                                                             | 13.8            | A   | 9.6             | B                        | 15.2            | A   | 9.5             |
| Pauline Blvd & S Main St              | B                                                             | 14.6            | A   | 5.8             | B                        | 14.5            | A   | 6.6             |
| E Stadium Blvd & S Main St            | D                                                             | 35.8            | E   | 79.5            | C                        | 29.3            | E   | 57.9            |
| Hill St & S Division St               | C                                                             | 30.8            | C   | 34.5            | C                        | 24.2            | B   | 18.6            |
| Packard St & Thompson St              | A                                                             | 4.5             | C   | 29.9            | A                        | 5.3             | C   | 22.1            |

**TABLE 2**  
**MODEL 7 VOLUME REDISTRIBUTION LOS AND DELAY**  
**EB & WB E STADIUM BLVD AND NB & SB S STATE ST CLOSED**

| Location                              | Model 7 (EB & WB E Stadium Blvd and NB & SB S State St Closed) Volume Redistribution |                 |     |                 |                          |                 |     |                 |
|---------------------------------------|--------------------------------------------------------------------------------------|-----------------|-----|-----------------|--------------------------|-----------------|-----|-----------------|
|                                       | With Existing Signal Timings                                                         |                 |     |                 | With Mitigation Measures |                 |     |                 |
|                                       | AM                                                                                   |                 | PM  |                 | AM                       |                 | PM  |                 |
|                                       | LOS                                                                                  | Delay (sec/veh) | LOS | Delay (sec/veh) | LOS                      | Delay (sec/veh) | LOS | Delay (sec/veh) |
| Eisenhower & State St                 | D                                                                                    | 39.6            | C   | 34.5            | D                        | 39.0            | D   | 36.9            |
| WB I-94 Ramp & Ann Arbor-Saline Rd    | C                                                                                    | 24.1            | D   | 36.7            | C                        | 24.1            | D   | 36.7            |
| EB I-94 Ramp & Ann Arbor-Saline Rd    | A                                                                                    | 8.9             | B   | 14.5            | A                        | 8.9             | B   | 14.5            |
| E Stadium Blvd & Packard St           | F                                                                                    | 227.7           | F   | 205.7           | F                        | 92.2            | F   | 112.4           |
| Scio Church Rd & S Main St            | B                                                                                    | 19.7            | E   | 58.7            | B                        | 19.9            | D   | 36.9            |
| Eisenhower Pkwy & Ann Arbor-Saline Rd | C                                                                                    | 27.6            | D   | 40.5            | C                        | 27.6            | D   | 40.5            |
| Eisenhower Pkwy & S Main St           | F                                                                                    | 81.8            | F   | 103.3           | C                        | 22.8            | D   | 45.8            |
| S Main St & Ann Arbor-Saline Rd       | D                                                                                    | 42.1            | F   | 95.1            | C                        | 26.2            | C   | 23.9            |
| Stimson St & S State St               | A                                                                                    | 8.8             | A   | 9.4             | A                        | 2.3             | A   | 0.1             |
| E Hoover Ave & S State St             | B                                                                                    | 14.7            | B   | 17.6            | B                        | 13.4            | B   | 16.8            |
| Oakbrook Dr & S State St              | A                                                                                    | 6.3             | B   | 12.1            | A                        | 6.3             | B   | 12.1            |
| S State St & Packard St               | B                                                                                    | 19.7            | E   | 62.9            | B                        | 18.9            | C   | 25.7            |
| Briarwood Cr & S State St             | B                                                                                    | 13.0            | C   | 22.7            | B                        | 13.0            | C   | 22.7            |
| WB I-94 Ramp & S State St             | D                                                                                    | 38.0            | C   | 26.0            | D                        | 38.0            | C   | 26.0            |
| EB I-94 Ramp & S State St             | C                                                                                    | 30.3            | C   | 20.4            | C                        | 30.3            | C   | 20.4            |
| Eisenhower Pkwy & Boardwalk Dr        | A                                                                                    | 9.6             | C   | 26.7            | B                        | 12.2            | C   | 30.3            |
| Eisenhower Pkwy & S Industrial Hwy    | E                                                                                    | 64.0            | F   | 204.9           | D                        | 36.2            | E   | 60.6            |
| Hill St & S State St                  | B                                                                                    | 14.8            | C   | 21.9            | B                        | 12.3            | B   | 18.2            |
| E Stadium Blvd & E Park Pl            | C                                                                                    | 29.6            | D   | 42.1            | C                        | 27.8            | B   | 14.9            |
| Hill St & S Main St                   | C                                                                                    | 29.5            | E   | 78.6            | B                        | 13.9            | C   | 24.6            |
| Packard St & S Main St                | D                                                                                    | 35.0            | C   | 22.3            | B                        | 16.6            | C   | 23.0            |
| Granger Ave & Packard St              | D                                                                                    | 53.3            | B   | 19.8            | D                        | 41.8            | B   | 19.8            |
| S 5 <sup>th</sup> Ave & Packard St    | B                                                                                    | 17.2            | B   | 16.7            | B                        | 16.9            | B   | 17.4            |
| Hill St & Packard St                  | C                                                                                    | 31.9            | D   | 54.0            | B                        | 19.4            | C   | 31.2            |
| Stimson St & E Park Pl                | B                                                                                    | 12.5            | B   | 19.9            | B                        | 12.6            | B   | 19.3            |
| Packard St & Wells St                 | D                                                                                    | 46.4            | F   | 363.7           | B                        | 16.8            | F   | 297.2           |
| E Madison St & S Main St              | B                                                                                    | 14.5            | C   | 22.5            | B                        | 13.9            | C   | 22.0            |
| E Madison St & S Division St          | B                                                                                    | 15.5            | B   | 14.2            | B                        | 17.0            | B   | 19.9            |
| Packard St & S 4 <sup>th</sup> Ave    | B                                                                                    | 13.2            | B   | 11.5            | B                        | 15.1            | B   | 11.3            |
| Pauline Blvd & S Main St              | B                                                                                    | 16.0            | A   | 6.3             | B                        | 15.9            | A   | 7.8             |
| E Stadium Blvd & S Main St            | D                                                                                    | 37.3            | F   | 121.4           | C                        | 31.1            | F   | 82.0            |
| Hill St & S Division St               | D                                                                                    | 43.3            | E   | 59.7            | C                        | 25.7            | C   | 22.4            |
| Packard St & Thompson St              | A                                                                                    | 3.7             | C   | 25.1            | A                        | 4.1             | C   | 20.9            |

## Summary of Mitigation Measures by Roadway Closures and Peak Periods

| Intersection Node Number / Name | EB and WB Closure (Model 6)                                                                                                                                                                                                                                                     | EB and WB Closure (Model 6)                                                                                                                                                                                                                                                                                                                                                       | NB/SB/EB/WB Closure (Model 7)                                                                                                                                                                                                                                                   | NB/SB/EB/WB Closure (Model 7)                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 | AM                                                                                                                                                                                                                                                                              | PM                                                                                                                                                                                                                                                                                                                                                                                | AM                                                                                                                                                                                                                                                                              | PM                                                                                                                                                                                                                                                                                                                                                                                |
| #88, Stadium/Main               | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                       | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                       | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                         |
| #44, Stadium/Industrial         | <ul style="list-style-type: none"> <li>NB approach from (2 left + 1 shared thru/right) to (1 left + 1 thru + 1 right).</li> <li>Provide RTGA on NB approach</li> <li>Recall mode changed from EBT/WBT/NBL to WBL/NBR as this movement is part of detour route</li> </ul>        | <ul style="list-style-type: none"> <li>NB approach from (2 left + 1 shared thru/right) to (1 left + 1 thru + 1 right).</li> <li>Provide RTGA on NB approach</li> <li>Recall mode changed from EBT/WBT/NBL to WBL/NBR as this movement is part of detour route</li> </ul>                                                                                                          | <ul style="list-style-type: none"> <li>NB approach from (2 left + 1 shared thru/right) to (1 left + 1 thru + 1 right).</li> <li>Provide RTGA on NB approach</li> <li>Recall mode changed from EBT/WBT/NBL to WBL/NBR as this movement is part of detour route</li> </ul>        | <ul style="list-style-type: none"> <li>NB approach from (2 left + 1 shared thru/right) to (1 left + 1 thru + 1 right).</li> <li>Provide RTGA on NB approach</li> <li>Recall mode changed from EBT/WBT/NBL to WBL/NBR as this movement is part of detour route</li> </ul>                                                                                                          |
| #15, Stimson/State              | <ul style="list-style-type: none"> <li>--</li> </ul>                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>--</li> </ul>                                                                                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Recall mode changed from NB/SB to WBL</li> </ul>                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Recall mode changed from NB/SB to WBL</li> </ul>                                                                                                                                                                                                                                                                                           |
| #6, Stadium/Packard             | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                       | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                       | <ul style="list-style-type: none"> <li>Recall mode changed from EB/WB with min recall to NB/SB with min recall</li> </ul>                                                                                                                                                                                                                                                         |
| #10, Eisenhower/Main            | <ul style="list-style-type: none"> <li>Utilize Michigan left turn for left turn traffic from NB Main to WB Eisenhower</li> <li>Remove split phasing on Main</li> <li>SB Main approach from (1 left + 1 thru + 1 shared thru/right) to (2 left + 1 shared thru/right)</li> </ul> | <ul style="list-style-type: none"> <li>Utilize Michigan left turn for left turn traffic from NB Main to WB Eisenhower</li> <li>Remove split phasing on Main</li> <li>SB Main approach from (1 left + 1 thru + 1 shared thru/right) to (2 left + 1 shared thru/right)</li> <li>Consider installing temporary traffic signal at the crossover on Eisenhower east of Main</li> </ul> | <ul style="list-style-type: none"> <li>Utilize Michigan left turn for left turn traffic from NB Main to WB Eisenhower</li> <li>Remove split phasing on Main</li> <li>SB Main approach from (1 left + 1 thru + 1 shared thru/right) to (2 left + 1 shared thru/right)</li> </ul> | <ul style="list-style-type: none"> <li>Utilize Michigan left turn for left turn traffic from NB Main to WB Eisenhower</li> <li>Remove split phasing on Main</li> <li>SB Main approach from (1 left + 1 thru + 1 shared thru/right) to (2 left + 1 shared thru/right)</li> <li>Consider installing temporary traffic signal at the crossover on Eisenhower east of Main</li> </ul> |
| #27, Eisenhower/Industrial      | <ul style="list-style-type: none"> <li>SB approach from (1 left + 1 shared thru/right) to (1 shared left/thru + 2 right)</li> <li>Apply split phasing on Industrial approaches</li> </ul>                                                                                       | <ul style="list-style-type: none"> <li>SB approach from (1 left + 1 shared thru/right) to (1 shared left/thru + 2 right)</li> <li>Apply split phasing on Industrial approaches</li> </ul>                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>SB approach from (1 left + 1 shared thru/right) to (1 shared left/thru + 2 right)</li> <li>Apply split phasing on Industrial approaches</li> </ul>                                                                                       | <ul style="list-style-type: none"> <li>SB approach from (1 left + 1 shared thru/right) to (1 shared left/thru + 2 right)</li> <li>Apply split phasing on Industrial approaches</li> </ul>                                                                                                                                                                                         |
| #59, Wells/Packard              | <ul style="list-style-type: none"> <li>Add left turn storage on the SEB approach</li> </ul>                                                                                                                                                                                     | <ul style="list-style-type: none"> <li>Add left turn storage on the SEB approach</li> </ul>                                                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>Add left turn storage on the SEB approach</li> </ul>                                                                                                                                                                                     | <ul style="list-style-type: none"> <li>Add left turn storage on the SEB approach</li> </ul>                                                                                                                                                                                                                                                                                       |
| #57, Hill/Packard               | <ul style="list-style-type: none"> <li>Add right turn storage on the EB approach</li> </ul>                                                                                                                                                                                     | <ul style="list-style-type: none"> <li>Add right turn storage on the EB approach</li> <li>Add left turn phase to NB Packard left turn</li> </ul>                                                                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>Add right turn storage on the EB approach</li> </ul>                                                                                                                                                                                     | <ul style="list-style-type: none"> <li>Add right turn storage on the EB approach</li> <li>Add left turn phase to NB Packard left turn</li> </ul>                                                                                                                                                                                                                                  |

|                    |                 |                                                                                        |                 |                                                                                        |
|--------------------|-----------------|----------------------------------------------------------------------------------------|-----------------|----------------------------------------------------------------------------------------|
| #93, Hill/Division | • Add EBL phase | • Add EBL phase                                                                        | • Add EBL phase | • Add EBL phase                                                                        |
| #18, State/Packard | • --            | • SB State approach from (1 left + 1 shared thru/right) to (1 left + 1 thru + 1 right) | • --            | • SB State approach from (1 left + 1 shared thru/right) to (1 left + 1 thru + 1 right) |

#### Stadium/Industrial

Change in lane use on NB Industrial is not reflected in the mitigated models because the receiving lane for NBT traffic is not modeled.

#### Stimson/State

Field review shows NBR is already overlapped with WBL. This mitigation measure was removed from the table.

#### Eisenhower/Main

At the main intersection, the same mitigation measures now apply to both Model 6 and Model 7. At the crossover on Eisenhower east of Main, temporary traffic signal should be considered during the evening peak.

#### Hill/Packard

There is one wide lane on SEB Packard shared by all turning movements. Drivers going straight on Packard typically use the extra pavement width as a passing flare to get around vehicles waiting to make a left turn. All models use a left turn storage on this approach to account for this effect.

**TABLE 1**  
**MODEL 6 VOLUME REDISTRIBUTION LOS AND DELAY**  
**EB & WB E STADIUM BLVD CLOSED**

| Location                              | Model 6 (EB & WB E Stadium Blvd Closed) Volume Redistribution |                 |     |                 |                          |                 |     |                 |
|---------------------------------------|---------------------------------------------------------------|-----------------|-----|-----------------|--------------------------|-----------------|-----|-----------------|
|                                       | With Existing Signal Timings                                  |                 |     |                 | With Mitigation Measures |                 |     |                 |
|                                       | AM                                                            |                 | PM  |                 | AM                       |                 | PM  |                 |
|                                       | LOS                                                           | Delay (Sec/veh) | LOS | Delay (Sec/veh) | LOS                      | Delay (Sec/veh) | LOS | Delay (Sec/veh) |
| Eisenhower Pkwy & S State St          | D                                                             | 44.1            | E   | 58.0            | D                        | 40.8            | D   | 45.9            |
| WB I-94 Ramp & Ann Arbor-Saline Rd    | C                                                             | 24.1            | D   | 36.7            | C                        | 24.1            | D   | 36.7            |
| EB I-94 Ramp & Ann Arbor-Saline Rd    | A                                                             | 8.9             | B   | 14.5            | A                        | 8.9             | B   | 14.5            |
| E Stadium Blvd & Packard St           | D                                                             | 48.6            | E   | 65.0            | D                        | 39.5            | D   | 45.8            |
| Scio Church Rd & S Main St            | B                                                             | 16.7            | D   | 39.9            | B                        | 17.8            | C   | 31.5            |
| Eisenhower Pkwy & Ann Arbor-Saline Rd | C                                                             | 27.6            | D   | 40.5            | C                        | 27.5            | D   | 40.5            |
| Eisenhower Pkwy & S Main St           | D                                                             | 43.2            | E   | 58.5            | B                        | 18.9            | D   | 35.6            |
| S Main St & Ann Arbor-Saline Rd       | C                                                             | 23.2            | D   | 42.2            | C                        | 22.8            | C   | 21.2            |
| Stimson St & S State St               | C                                                             | 23.2            | C   | 25.1            | C                        | 22.7            | C   | 23.9            |
| E Hoover Ave & S State St             | B                                                             | 10.7            | B   | 13.8            | A                        | 9.3             | B   | 13.8            |
| Oakbrook Dr & S State St              | A                                                             | 6.6             | B   | 13.6            | A                        | 6.6             | B   | 13.6            |
| S State St & Packard St               | C                                                             | 26.0            | D   | 54.9            | C                        | 24.6            | D   | 52.9            |
| Briarwood Cr & S State St             | B                                                             | 11.8            | C   | 26.6            | B                        | 11.8            | C   | 26.6            |
| WB I-94 Ramp & S State St             | D                                                             | 48.8            | C   | 27.4            | D                        | 48.8            | C   | 27.4            |
| EB I-94 Ramp & S State St             | D                                                             | 36.0            | C   | 30.5            | D                        | 36.0            | C   | 30.5            |
| Eisenhower Pkwy & Boardwalk Dr        | A                                                             | 9.6             | C   | 24.4            | B                        | 13.2            | C   | 27.2            |
| Eisenhower Pkwy & S Industrial Hwy    | D                                                             | 54.4            | F   | 185.5           | D                        | 36.5            | D   | 49.5            |
| Hill St & S State St                  | C                                                             | 20.6            | C   | 21.0            | B                        | 18.9            | B   | 17.2            |
| E Stadium Blvd & E Park Pl            | C                                                             | 25.7            | C   | 31.7            | B                        | 12.2            | B   | 12.6            |
| Hill St & S Main St                   | B                                                             | 14.1            | D   | 49.9            | B                        | 10.0            | C   | 20.7            |
| Packard St & S Main St                | C                                                             | 26.6            | C   | 22.4            | B                        | 18.1            | C   | 21.8            |
| Granger Ave & Packard St              | B                                                             | 15.1            | B   | 12.7            | B                        | 15.4            | B   | 13.7            |
| S 5 <sup>th</sup> Ave & Packard St    | B                                                             | 17.1            | B   | 16.5            | B                        | 16.7            | B   | 16.7            |
| Hill St & Packard St                  | C                                                             | 27.8            | F   | 125.6           | B                        | 16.3            | D   | 41.9            |
| Stimson St & E Park Pl                | A                                                             | 5.6             | A   | 8.5             | A                        | 5.7             | A   | 8.2             |
| Packard St & Wells St                 | A                                                             | 6.7             | C   | 20.2            | A                        | 6.6             | B   | 13.5            |
| E Madison St & S Main St              | B                                                             | 14.1            | C   | 22.6            | B                        | 13.9            | C   | 21.9            |
| E Madison St & S Division St          | B                                                             | 15.4            | B   | 15.0            | B                        | 16.9            | C   | 20.1            |
| Packard St & S 4 <sup>th</sup> Ave    | B                                                             | 13.8            | A   | 9.6             | B                        | 15.2            | A   | 9.5             |
| Pauline Blvd & S Main St              | B                                                             | 14.6            | A   | 5.8             | B                        | 14.5            | A   | 6.6             |
| E Stadium Blvd & S Main St            | D                                                             | 35.8            | E   | 79.5            | C                        | 29.3            | E   | 57.9            |
| Hill St & S Division St               | C                                                             | 30.8            | C   | 34.5            | C                        | 24.2            | B   | 17.6            |
| Packard St & Thompson St              | A                                                             | 4.5             | C   | 29.9            | A                        | 5.3             | B   | 19.2            |

**TABLE 2**  
**MODEL 7 VOLUME REDISTRIBUTION LOS AND DELAY**  
**EB & WB E STADIUM BLVD AND NB & SB S STATE ST CLOSED**

| Location                              | Model 7 (EB & WB E Stadium Blvd and NB & SB S State St Closed) Volume Redistribution |                 |     |                 |                          |                 |     |                 |
|---------------------------------------|--------------------------------------------------------------------------------------|-----------------|-----|-----------------|--------------------------|-----------------|-----|-----------------|
|                                       | With Existing Signal Timings                                                         |                 |     |                 | With Mitigation Measures |                 |     |                 |
|                                       | AM                                                                                   |                 | PM  |                 | AM                       |                 | PM  |                 |
|                                       | LOS                                                                                  | Delay (sec/veh) | LOS | Delay (sec/veh) | LOS                      | Delay (sec/veh) | LOS | Delay (sec/veh) |
| Eisenhower & State St                 | D                                                                                    | 39.6            | C   | 34.5            | D                        | 39.0            | D   | 36.9            |
| WB I-94 Ramp & Ann Arbor-Saline Rd    | C                                                                                    | 24.1            | D   | 36.7            | C                        | 24.1            | D   | 36.7            |
| EB I-94 Ramp & Ann Arbor-Saline Rd    | A                                                                                    | 8.9             | B   | 14.5            | A                        | 8.9             | B   | 14.5            |
| E Stadium Blvd & Packard St           | F                                                                                    | 227.7           | F   | 205.7           | F                        | 92.2            | F   | 112.4           |
| Scio Church Rd & S Main St            | B                                                                                    | 19.7            | E   | 58.7            | B                        | 19.9            | D   | 36.9            |
| Eisenhower Pkwy & Ann Arbor-Saline Rd | C                                                                                    | 27.6            | D   | 40.5            | C                        | 27.6            | D   | 40.5            |
| Eisenhower Pkwy & S Main St           | F                                                                                    | 81.8            | F   | 103.3           | C                        | 22.8            | D   | 45.8            |
| S Main St & Ann Arbor-Saline Rd       | D                                                                                    | 42.1            | F   | 95.1            | C                        | 26.2            | C   | 23.9            |
| Stimson St & S State St               | A                                                                                    | 8.8             | A   | 9.4             | A                        | 2.3             | A   | 0.1             |
| E Hoover Ave & S State St             | B                                                                                    | 14.7            | B   | 17.6            | B                        | 13.5            | B   | 16.8            |
| Oakbrook Dr & S State St              | A                                                                                    | 6.3             | B   | 12.1            | A                        | 6.3             | B   | 12.1            |
| S State St & Packard St               | B                                                                                    | 19.7            | E   | 62.9            | B                        | 19.5            | C   | 24.3            |
| Briarwood Cr & S State St             | B                                                                                    | 13.0            | C   | 22.7            | B                        | 13.0            | C   | 22.7            |
| WB I-94 Ramp & S State St             | D                                                                                    | 38.0            | C   | 26.0            | D                        | 38.0            | C   | 26.0            |
| EB I-94 Ramp & S State St             | C                                                                                    | 30.3            | C   | 20.4            | C                        | 30.3            | C   | 20.4            |
| Eisenhower Pkwy & Boardwalk Dr        | A                                                                                    | 9.6             | C   | 26.7            | B                        | 12.2            | C   | 30.3            |
| Eisenhower Pkwy & S Industrial Hwy    | E                                                                                    | 64.0            | F   | 204.9           | D                        | 36.2            | E   | 60.6            |
| Hill St & S State St                  | B                                                                                    | 14.8            | C   | 21.9            | B                        | 13.0            | B   | 19.7            |
| E Stadium Blvd & E Park Pl            | C                                                                                    | 29.6            | D   | 42.1            | C                        | 27.8            | B   | 14.9            |
| Hill St & S Main St                   | C                                                                                    | 29.5            | E   | 78.6            | B                        | 13.9            | C   | 24.6            |
| Packard St & S Main St                | D                                                                                    | 35.0            | C   | 22.3            | B                        | 16.6            | C   | 23.0            |
| Granger Ave & Packard St              | D                                                                                    | 53.3            | B   | 19.8            | D                        | 41.5            | C   | 21.7            |
| S 5 <sup>th</sup> Ave & Packard St    | B                                                                                    | 17.2            | B   | 16.7            | B                        | 16.9            | B   | 17.4            |
| Hill St & Packard St                  | C                                                                                    | 31.9            | D   | 54.0            | B                        | 17.8            | D   | 54.4            |
| Stimson St & E Park Pl                | B                                                                                    | 12.5            | B   | 19.9            | B                        | 12.6            | B   | 19.3            |
| Packard St & Wells St                 | D                                                                                    | 46.4            | F   | 363.7           | B                        | 9.1             | D   | 37.6            |
| E Madison St & S Main St              | B                                                                                    | 14.5            | C   | 22.5            | B                        | 13.9            | C   | 22.0            |
| E Madison St & S Division St          | B                                                                                    | 15.5            | B   | 14.2            | B                        | 17.0            | B   | 19.9            |
| Packard St & S 4 <sup>th</sup> Ave    | B                                                                                    | 13.2            | B   | 11.5            | B                        | 15.1            | B   | 11.3            |
| Pauline Blvd & S Main St              | B                                                                                    | 16.0            | A   | 6.3             | B                        | 15.9            | A   | 7.8             |
| E Stadium Blvd & S Main St            | D                                                                                    | 37.3            | F   | 121.4           | C                        | 31.1            | F   | 82.0            |
| Hill St & S Division St               | D                                                                                    | 43.3            | E   | 59.7            | C                        | 25.8            | C   | 21.4            |
| Packard St & Thompson St              | A                                                                                    | 3.7             | C   | 25.1            | A                        | 4.1             | C   | 20.9            |





Client: City of Ann Arbor  
Project Name: East Stadium Boulevard Bridge Replacement Project  
Location: City of Ann Arbor  
Project Number: 12940111  
Issue Date: December 22, 2009

**PROJECT  
MEMORANDUM**

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TO: Mike Nearing, PE  
City of Ann Arbor

FROM: Matt Klawon, PE

SUBJECT: East Stadium Boulevard Detour Route Evaluation – Proposed Mitigation Measures

### **1.0 East Stadium Boulevard Closure (Model 6) Mitigation Measures**

Upon the closure of East Stadium Boulevard for bridge construction traffic will be advised to follow the posted detour route that utilizes Main Street, Eisenhower Parkway and Industrial Highway around the project area. For those drivers familiar with the local roadways, it is expected that they may attempt to use alternative routes to seek shorter delays around the project area. The anticipated user-selected detour as represented in Model 6 utilizes Main Street, Hill Street and Packard Street.

The percentages of traffic assigned to the posted and user-selected detour routes were estimated based on engineering judgment to derive estimated traffic volumes to be used in the model which has led to the development of these proposed mitigation measures. The goal of the proposed mitigation measures is to accommodate the anticipated traffic volumes on the posted detour route, user-selected detour routes, and other locations in the study area.

Mitigation measures as listed by intersection and described below include changes in intersection approach lane use, traffic signal equipment configuration, traffic signal controller settings, and the addition of temporary traffic signals. **Table 1** provides a comparison of the study area intersections operating under this detour configuration without and with mitigation measures to illustrate the benefit of the proposed mitigation measures as a result of our Model 6 analysis.

#### **Main & Stadium**

Adjust the traffic signal controller vehicle recall settings from EB/WB to NB/SB. During the closure of East Stadium Boulevard most traffic on the EB approach will be making left/right turns at the intersection and traffic volumes on the WB approach will be very light since the roadway is closed.

#### **Industrial & Stadium**

Change the lane use on the NB approach from (2 left + 1 shared thru/right) to (1 left + 1 thru + 1 right), as the NB left-turn traffic volumes will be very light during the closure of East Stadium Boulevard and NB right-turn is part of the posted detour route. Traffic signal controller vehicle recall settings should be adjusted from EBT/WBT/NBL to WBL. In addition, a right-turn green arrow (RTGA) signal head should be added for the NB approach and overlapped with WBL phase.

#### **Packard & Stadium**

Adjust the traffic signal controller vehicle recall settings from EB/WB to NB/SB, as the NB and SB approaches are expected to carry heavier traffic volumes than the EB and WB approaches during the closure of East Stadium Boulevard.

#### **Eisenhower & Main**

During the closure of East Stadium Boulevard, this intersection is part of the posted detour route and is expected to see significant changes in traffic patterns. The SBL and WBR movements are expected to be significantly heavier during the closure than under normal conditions.

Implement a Michigan left turn for NB left-turn traffic from Main Street to Eisenhower Parkway using the median crossover located east of the intersection. The signal currently operates with split phasing on NB and SB Main Street approaches. Remove the split phasing operation and operate SBL as a protected leading left-turn movement. Additionally, modify the SB Main Street approach lane use from (1 left + 1 thru + 1 shared thru/right) to (2 left + 1 shared thru/right). At the crossover on Eisenhower Parkway, east of Main Street, install a temporary traffic signal due to the heavy WB traffic on Eisenhower Parkway that would leave few gaps available for the crossover traffic.

### **Boardwalk & Eisenhower**

As Eisenhower Parkway is part of the posted detour route, the EB and WB through volumes are expected to experience significant increases during the closure of East Stadium Boulevard. Microscopic simulation models showed that the EBL and WBL movements experience long delays when operated as permissive movements with the existing traffic signal configuration. The mitigation measure for this intersection is to install EBL and WBL left turn signal heads and operate these two left-turn movements as permissive-protected.

### **Eisenhower & Industrial**

The EBL and SBR traffic volumes are expected to be significantly higher during the closure of East Stadium Boulevard than under normal conditions. Change SB Industrial Highway approach lane use from (1 left + 1 shared thru/right) to (1 shared left/thru + 2 right), RTGA on the SB approach and overlapping SBR with EBL. Field measurements indicated that sufficient width on the SB approach should be available to accommodate a 150' right turn storage lane. Split phasing on the NB and SB approaches is recommended to allow more time to be shifted to better serve detour route movements.

### **Hill & Packard**

Being part of the user-selected detour route, the EBR and NBL volumes at this intersection are expected to become heavier during East Stadium Boulevard closure. The addition of right turn storage on the EB Hill approach and left turn storage and left turn signal heads on the NWB Packard Street approach are recommended.

### **Division & Hill**

It is anticipated that the through traffic on Hill Street will become heavier during the closure of East Stadium Boulevard. Therefore, there will be fewer gaps in the WB traffic that would allow EBL traffic to complete the turn movement. The addition of an EB left-turn signal would help in maintaining an acceptable LOS for EBL traffic and preventing EBL traffic from queuing up and blocking the EB through travel lane.

### **Packard & Wells**

Consider changing the SEB Packard Street approach lane use to provide one left turn storage lane and one through lane, as this will help progression traffic along Packard Street, which is part of the user-selected detour route.

### **Signal Timings Adjustments**

Consider implementing construction signal timings at the following intersections to accommodate changes in traffic patterns during the closure of East Stadium Boulevard.

- |                        |                           |                      |
|------------------------|---------------------------|----------------------|
| - Main & Stadium       | - Industrial & Stimson    | - Hill & Packard     |
| - Main & Packard       | - Eisenhower & Main       | - Hill & Main        |
| - Industrial & Stadium | - Eisenhower & State      | - Division & Hill    |
| - Packard & Stadium    | - Boardwalk & Eisenhower  | - Division & Packard |
| - State & Stimson      | - Eisenhower & Industrial | - Packard & Wells    |

A comparison of the Model 6 study area intersection operations under existing configurations and with the proposed mitigation measures is presented in **Table 1**.

## **2.0 East Stadium Boulevard and State Street Closure (Model 7) Mitigation Measures**

In this scenario, both East Stadium Boulevard and State Street are expected to be closed in Model 7. The posted detour route for NB State Street traffic includes Stimson Street, Industrial Highway, Stadium Boulevard and Packard. The posted detour route for SB State Street traffic includes Hill Street, Main Street and Eisenhower Parkway. The proposed mitigation measures for Model 7 conditions include all the mitigation measures listed above for Model 6 conditions and the additional items as described below.

### **Packard & State**

Change the SB State Street approach lane use from (1 left + 1 shared thru/right) to (1 left + 1 thru + 1 right) with approximately 50' storage. The space required for this proposed right turn lane is currently being used as metered on-street parking.

### **State & Stimson**

Adjust traffic signal controller vehicle recall settings from NB/SB to WBL, as during the closure of State Street most traffic on the NB approach will turn right at the intersection and traffic volumes on the SB approach will be very light.

A comparison of the Model 7 study area intersection operations under existing configurations and with proposed mitigation measures is presented in **Table 2**.

All recommended mitigation measures are based on the signal timing permits as provided to URS by the City of Ann Arbor in 2007 and are subject to change based on any traffic signal equipment or operational modifications made in the ensuing years.

**TABLE 1**  
**MODEL 6 LOS AND DELAY**  
**EB & WB E STADIUM BLVD CLOSED**

| Location                           | Model 6 (EB & WB E Stadium Blvd Closed) |                 |     |                 |                          |                 |     |                 |
|------------------------------------|-----------------------------------------|-----------------|-----|-----------------|--------------------------|-----------------|-----|-----------------|
|                                    | With Existing Signal Timings            |                 |     |                 | With Mitigation Measures |                 |     |                 |
|                                    | AM                                      |                 | PM  |                 | AM                       |                 | PM  |                 |
|                                    | LOS                                     | Delay (Sec/veh) | LOS | Delay (Sec/veh) | LOS                      | Delay (Sec/veh) | LOS | Delay (Sec/veh) |
| Eisenhower Pkwy & State            | D                                       | 44.1            | E   | 58              | D                        | 40.8            | D   | 45.9            |
| WB I-94 & Ann Arbor-Saline         | C                                       | 24.1            | D   | 36.7            | C                        | 24.1            | D   | 36.7            |
| EB I-94 & Ann Arbor-Saline         | A                                       | 8.9             | B   | 14.5            | A                        | 8.9             | B   | 14.5            |
| Stadium Blvd & Packard             | D                                       | 48.6            | E   | 65              | D                        | 39.5            | D   | 45.8            |
| Scio Church & Main                 | B                                       | 16.7            | D   | 39.9            | B                        | 17.8            | C   | 31.5            |
| Eisenhower Pkwy & Ann Arbor-Saline | C                                       | 27.6            | D   | 40.5            | C                        | 27.5            | D   | 40.5            |
| Eisenhower Pkwy & Main             | D                                       | 43.2            | E   | 58.5            | B                        | 18.9            | D   | 35.6            |
| Main & Ann Arbor-Saline            | C                                       | 23.2            | D   | 42.2            | C                        | 22.8            | C   | 21.2            |
| Stimson & State                    | C                                       | 23.2            | C   | 25.1            | C                        | 22.7            | C   | 23.9            |
| Hoover & State                     | B                                       | 10.7            | B   | 13.8            | A                        | 9.2             | B   | 13.8            |
| Oakbrook & State                   | A                                       | 6.6             | B   | 13.6            | A                        | 6.6             | B   | 13.6            |
| State & Packard                    | C                                       | 26              | D   | 54.9            | C                        | 26.4            | D   | 54.6            |
| Briarwood Cir & State              | B                                       | 11.8            | C   | 26.6            | B                        | 11.8            | C   | 26.6            |
| WB I-94 & NB State                 | E                                       | 57.1            | C   | 28.1            | E                        | 57.1            | C   | 28.3            |
| EB I-94 & SB State                 | D                                       | 35.9            | C   | 31.2            | D                        | 35.9            | C   | 27.9            |
| Eisenhower Pkwy & Boardwalk        | A                                       | 9.6             | C   | 24.4            | B                        | 12.3            | C   | 27.9            |
| Eisenhower Pkwy & Industrial       | D                                       | 54.4            | F   | 185.5           | C                        | 32              | D   | 50.8            |
| Hill & State                       | C                                       | 20.6            | C   | 21              | B                        | 18.3            | B   | 17.3            |
| Stadium Blvd & Industrial          | C                                       | 25.7            | C   | 31.7            | B                        | 12.2            | B   | 12.6            |
| Hill & Main                        | B                                       | 14.1            | D   | 50              | B                        | 10.1            | C   | 21.5            |
| Packard & Main                     | C                                       | 26.6            | C   | 22.4            | B                        | 18.1            | C   | 21.9            |
| Granger & Packard                  | B                                       | 15.1            | B   | 12.7            | B                        | 15              | B   | 13.7            |
| Fifth & Packard                    | B                                       | 17.1            | B   | 16.5            | B                        | 16.7            | B   | 16.7            |
| Hill & Packard                     | C                                       | 27.8            | F   | 125.6           | B                        | 12.2            | D   | 40.2            |
| Stimson & Industrial               | A                                       | 5.6             | A   | 8.5             | A                        | 5.7             | A   | 8.2             |
| Packard & Wells                    | A                                       | 6.7             | C   | 20.2            | A                        | 6.5             | B   | 13.5            |
| Madison & Main                     | B                                       | 13.5            | C   | 23.8            | B                        | 13.4            | C   | 23.1            |
| Madison & Division                 | B                                       | 15.4            | B   | 15              | B                        | 17              | B   | 13.3            |
| Packard & Fourth                   | B                                       | 13.8            | A   | 9.6             | B                        | 15.2            | A   | 9.5             |
| Pauline & Main                     | B                                       | 14.6            | A   | 5.8             | B                        | 14.5            | A   | 6.7             |
| Stadium Blvd & Main                | D                                       | 35.8            | E   | 79.5            | C                        | 29.3            | E   | 57.9            |
| Hill & Division                    | C                                       | 30.8            | C   | 34.5            | C                        | 25.9            | B   | 17.2            |
| Packard & Thompson                 | A                                       | 4.5             | C   | 29.9            | A                        | 7.8             | C   | 21.5            |

**TABLE 2**  
**MODEL 7 LOS AND DELAY**  
**EB & WB E STADIUM BLVD AND NB & SB S STATE ST CLOSED**

| Location                           | Model 7 (EB & WB E Stadium Blvd and NB & SB S State St Closed) |                 |     |                 |                          |                 |     |                 |
|------------------------------------|----------------------------------------------------------------|-----------------|-----|-----------------|--------------------------|-----------------|-----|-----------------|
|                                    | With Existing Signal Timings                                   |                 |     |                 | With Mitigation Measures |                 |     |                 |
|                                    | AM                                                             |                 | PM  |                 | AM                       |                 | PM  |                 |
|                                    | LOS                                                            | Delay (sec/veh) | LOS | Delay (sec/veh) | LOS                      | Delay (sec/veh) | LOS | Delay (sec/veh) |
| Eisenhower Pkwy & State            | D                                                              | 39.6            | C   | 34.5            | D                        | 39              | D   | 36.9            |
| WB I-94 & Ann Arbor-Saline         | C                                                              | 24.1            | D   | 36.7            | C                        | 24.1            | D   | 36.7            |
| EB I-94 & Ann Arbor-Saline         | A                                                              | 8.9             | B   | 14.5            | A                        | 8.9             | B   | 14.5            |
| Stadium Blvd & Packard             | F                                                              | 227.7           | F   | 205.7           | F                        | 92.2            | F   | 112.4           |
| Scio Church & Main                 | B                                                              | 19.7            | E   | 58.7            | B                        | 19.9            | D   | 36.9            |
| Eisenhower Pkwy & Ann Arbor-Saline | C                                                              | 27.6            | D   | 40.5            | C                        | 27.6            | D   | 40.5            |
| Eisenhower Pkwy & Main             | F                                                              | 81.8            | F   | 103.3           | C                        | 22.8            | D   | 45.8            |
| Main & Ann Arbor-Saline            | D                                                              | 42.1            | F   | 95.1            | C                        | 26.2            | C   | 23.9            |
| Stimson & State                    | A                                                              | 8.8             | A   | 9.4             | A                        | 2.3             | A   | 0.1             |
| Hoover & State                     | B                                                              | 14.7            | B   | 17.6            | B                        | 13.4            | B   | 16.8            |
| Oakbrook & State                   | A                                                              | 6.3             | B   | 12.1            | A                        | 6.3             | B   | 12.1            |
| State & Packard                    | B                                                              | 19.7            | E   | 62.9            | C                        | 20.9            | C   | 26.6            |
| Briarwood Cir & State              | B                                                              | 13              | C   | 22.7            | B                        | 13              | C   | 22.7            |
| WB I-94 & NB State                 | D                                                              | 47.1            | C   | 27.8            | D                        | 47.1            | C   | 27.8            |
| EB I-94 & SB State                 | C                                                              | 30.3            | C   | 21.1            | C                        | 30.3            | C   | 21.1            |
| Eisenhower Pkwy & Boardwalk        | A                                                              | 9.6             | C   | 26.7            | B                        | 12.1            | C   | 31.1            |
| Eisenhower Pkwy & Industrial       | E                                                              | 64              | F   | 204.9           | C                        | 33.3            | E   | 56.1            |
| Hill & State                       | B                                                              | 14.8            | C   | 21.9            | B                        | 14.6            | B   | 18.7            |
| Stadium Blvd & Industrial          | C                                                              | 29.6            | D   | 42.1            | C                        | 27.8            | B   | 14.9            |
| Hill & Main                        | C                                                              | 29.5            | E   | 78.7            | B                        | 13.8            | C   | 24.8            |
| Packard & Main                     | D                                                              | 35              | C   | 22.3            | B                        | 16.6            | C   | 23              |
| Granger & Packard                  | D                                                              | 53.3            | B   | 19.8            | D                        | 41.5            | C   | 21.5            |
| Fifth & Packard                    | B                                                              | 17.2            | B   | 16.7            | B                        | 16.9            | B   | 17.3            |
| Hill & Packard                     | C                                                              | 31.9            | D   | 54              | C                        | 23              | D   | 39.8            |
| Stimson & Industrial               | B                                                              | 12.5            | B   | 19.9            | B                        | 12.6            | B   | 19.3            |
| Packard & Wells                    | D                                                              | 46.4            | F   | 363.7           | A                        | 8.6             | D   | 38              |
| Madison & Main                     | B                                                              | 13.7            | C   | 23.9            | B                        | 13.1            | C   | 23.4            |
| Madison & Division                 | B                                                              | 15.5            | B   | 14.2            | B                        | 17              | B   | 17.4            |
| Packard & Fourth                   | B                                                              | 13.2            | B   | 11.5            | B                        | 15.1            | B   | 11.3            |
| Pauline & Main                     | B                                                              | 16              | A   | 6.3             | B                        | 15.9            | A   | 7.8             |
| Stadium Blvd & Main                | D                                                              | 37.3            | F   | 121.4           | C                        | 31.1            | F   | 82              |
| Hill & Division                    | D                                                              | 43.3            | E   | 59.7            | C                        | 24.1            | C   | 21.9            |
| Packard & Thompson                 | A                                                              | 3.7             | C   | 25.1            | A                        | 9.6             | B   | 19.7            |