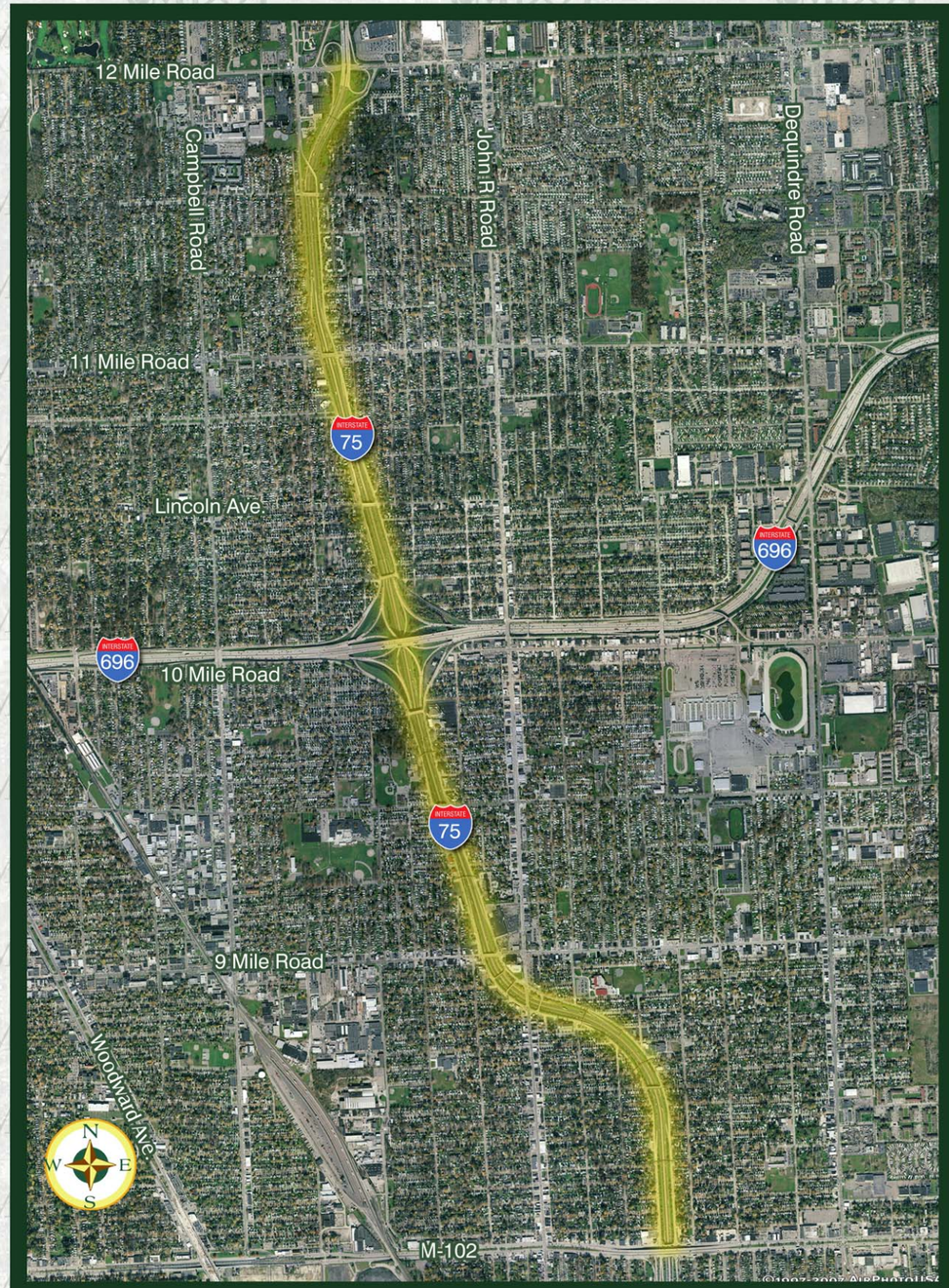


# I-75 Engineering Report

## *M-102 to South of 12 Mile Road*

CS 63174 – JN 45700 and 100948

*Submitted to:*

MDOT

*Submitted by:*

***Parsons Brinckerhoff Michigan, Inc.***

*In association with:*

*Parsons, CH2MHill, Somat Engineering, Advanced Geomatics, Corradino Group, MACTEC Engineering and Consulting, and T-Concepts.*

*August 2010*

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Appendix G Tunnel Option Feasibility Memorandum

Appendix H Intelligent Transportation System (ITS) Initiatives and Strategies

Appendix I Cost Estimate

## LIST OF SEPARATELY BOUND REPORTS PREVIOUSLY SUBMITTED

*Preliminary Engineering Report on Geotechnical Conditions for Structures, I-75 EPE Study From 8 Mile Road to South of 12 Mile Road, Oakland County, Michigan, CS: 63174 – JN: 45700,* by Somat Engineering, February 1, 2010.

*Data Report on Geotechnical Investigation, I-75 EPE Study for the Roadway Pavement From 8 Mile Road to South of 12 Mile Road, Oakland County, Michigan, CS: 63174 – JN: 45700,* by Somat Engineering, February 1, 2010.

*Bridge Studies, I-75 from M-102 (8 Mile Road) to South of 12 Mile Road, Oakland County, MI, CS 63103/63174,* by PB, March 2010.

*Drainage Study, I-75 8 Mile Road to 12 Mile Road, Engineering Report (CS 63174 – JN 45700,* by CH2MHill, December 2009.

*I-75 South MOTSIM, Maintenance of Traffic Simulation Model,* by T-Concepts Corp., December 2009.

*Maintenance of Traffic Technical Memorandum, I-75 from M-102 to South of 12 Mile Road Engineering Report (CS-63174 – JN 45700),* by Parsons, December 18, 2009.

*Right-of-Way Identification Maps, I-75 Engineering Report, M-102 to South of 12 Mile Road, CS 63174 – JN 45700 and 100948,* by PB, January 2010.

*Survey Notes For: Survey Order 2001-0365, Control Section 63174, JN 45700, Route I-75, Location and Project Limits: I-75 from M-102 to 12 Mile Road, cities of Hazel Park, Royal Oak, & Madison Heights, Oakland County,* by Advanced Geomatics, August 7, 2009.

*Engineering Report Criteria & Calculations, Proposed Reconstruction of 1-75 from M-102 to South of 12 Mile Road, Oakland County, Michigan,* by PB, March 2008.

# 0.0 Executive Summary

## *E1.0 Introduction and Project Overview*

I-75 is an interstate freeway that runs north-south from northern Michigan to southern Florida. It is a vital transportation corridor for the United States that also connects with other interstate freeways. This Engineering Report is a continuation of the original planning and engineering efforts conducted for development of the *Final Environmental Impact Statement, I-75 from M-102 to M-59, Oakland County, Michigan,* (FEIS) from 2005. The continued work is divided into two sections: the southern section extends from M-102 (8 Mile Road) to south of 12 Mile Road and is a depressed urban freeway section; the northern section extends from south of 12 Mile Road to south of M-59 and is an at-grade/elevated rural freeway section. Figure E-1 provides an overview of the study corridor. This Engineering Report covers the southern section of I-75 from M-102 (8 Mile Road) to south of 12 Mile Road, which is approximately four miles in length and includes four interchanges and six local cross roads.

I-75 was built in the 1960s. It is the most traveled freeway in Michigan and is a gateway for travel north and south. In the study vicinity, I-75 parallels Woodward Avenue to the west, in a stair-step manner. It is used by many Oakland County residents and workers for intra-county/local trips. It connects Detroit and Flint and is an important corridor to businesses and residents alike. Studies have shown that the widening of I-75 is beneficial for the existing and future economic growth in the county.

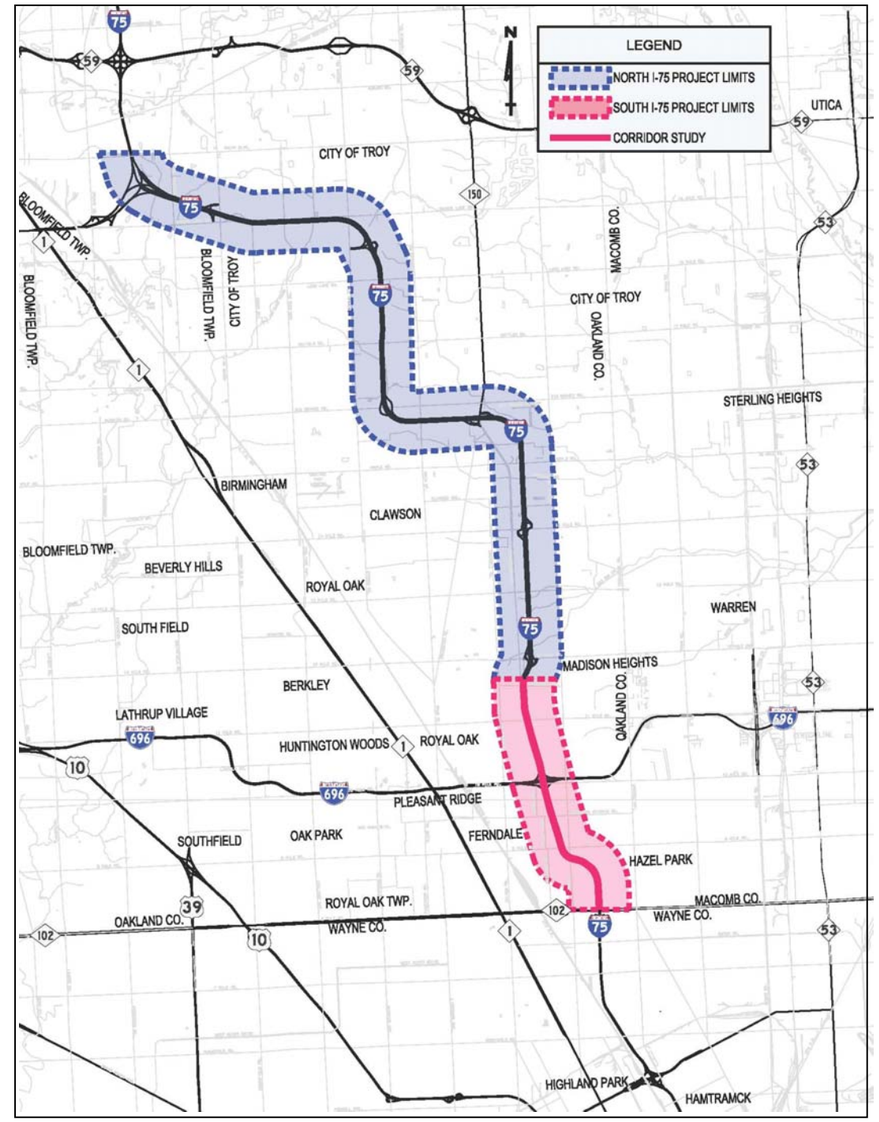
The following paragraph from the Purpose and Need section of the FEIS accurately defines the benefits of the freeway segment:

> "The purpose of the proposed project is to increase the capacity of the transportation infrastructure in the I-75 corridor to meet travel demand for personal mobility and goods movement. Meeting the purpose of the project will improve motorist safety, travel efficiency, and reliability. These are essential both to personal mobility and to the movement of freight. I-75 will continue to play a role as a link in the nation's national system of Interstate and Defense Highways. I-75 connects Detroit and its international border crossings with the expanding economic development in Oakland County. Oakland County has the largest employment base of any county in Michigan and the most manufacturing plants, and is home to over 65 percent of the Detroit Metropolitan Statistical Areas major automotive equipment suppliers. I-75 also links the Southeast Michigan region with the rest of the state to the north. It is the sole means of high-speed freight movement to a large section of Michigan, as it is the only freeway that extends to the north state limit and freight rail coverage is limited."

The project need for increased corridor capacity is driven by growth that has occurred along I-75 since its construction. The needs for the proposed action are attributable to the following:

- Population and employment growth
- Existing traffic and level-of-service
- Future traffic and level-of-service
- Current design standards
- Physical condition and relative performance of I-75
- Safety
- Movement of goods and services

**Figure E-1 Overview of the I-75 Study Corridor**



This Engineering Report provides the design, estimates, and impacts to comprehensively upgrade and provide additional capacity to the freeway.

## *E1.1 Project Background*

Since 1990, a number of studies have been conducted by the Michigan Department of Transportation (MDOT) recommending the need to add an additional lane on I-75 in each direction throughout Oakland County. This need has been identified in areas with less than four lanes in each direction due to the forecasted increased traffic volumes and development. Recommendations were made to improve the interchanges, arterial street system, and intelligent transportation system (ITS) network.

The development of the FEIS for I-75 began in 2003, based on the need from prior studies and was completed in 2005. The FEIS recommended widening I-75 from three to four through lanes in each direction between M-102 and just south of M-59. The Preferred Alternative in the FEIS was to construct one lane in each direction between M-102 and South Boulevard. The additional lane would be limited to High-Occupancy Vehicles (HOV) during peak hours and would be a lane for general use during the remaining hours.

In the summer of 2009, a tanker fire caused the collapse of the 9 Mile Road bridge over I-75. In the fall of 2009, the 9 Mile Road bridge was rebuilt in the same location consistent with future recommendations. I-75 under 9 Mile Road was lowered to meet minimum required underclearance due to geometric improvements.

This report details the reconstruction along I-75 and upgrade of the interchanges, local road crossings, and service drives. The four interchanges with ramp upgrades are:

- M-102 (8 Mile Road) (two northern ramps)
- 9 Mile/John R Road
- I-696
- 11 Mile Road

The report also reviewed the existing and proposed drainage, traffic analysis, HOV, ITS, and maintenance of traffic.

## *E2.0 Design Criteria*

The geometric design criteria used for the freeway, interchanges, ramps, service drives, and local roads are detailed in Section 3.0. The goal of the new design for the project is to meet the design criteria for all design elements within the project limits.

## *E3.0 Preliminary Design Analysis*

The various areas of refining the FEIS Preferred Alternative to add an additional part-time HOV lane in each direction were addressed.

## *E3.1 Traffic Operations*

The existing peak hour traffic volumes and levels of service indicate congestion on I-75 north of I-696. The design year (2025) traffic operations revealed an increased need for additional capacity. In the year 2025, No-Build Alternative, the level-of-service (LOS) will be LOS E or F for all segments during the AM and/or PM peak hours of the day.

In 2025 with the Preferred Alternative, the fourth lane will operate as an HOV lane in the AM and PM peak hours, and all segments will operate at LOS E or better. In both peak periods, three segments would operate at LOS D or better and one would operate at LOS E (11 Mile Road to 12 Mile Road). These are acceptable conditions under limited circumstances in constrained urban situations in the peak hours of the day.

## *E3.2 Recommendations for HOV Implementation and Operation*

The proposed part-time HOV lane will be located next to the median in both directions. When not operational, this fourth lane will serve as a general purpose lane. Therefore, the designated pavement markings and signing for the lane will conform to part-time HOV lane operations as prescribed in the Manual on Uniform Traffic Control Devices (MUTCD). The following is a list of recommendations for consideration with respect to the implementation and operation of HOV facilities on I-75 based on best practices and engineering judgment.

**HOV Justification** – It is recommended that the HOV lane provide at least one minute of time savings per mile to HOV users compared to users of the general purpose lanes in order to justify the need for the HOV lane.

**Beginning and ending the HOV lanes** - Special HOV signage is recommended and specific examples are given in Section 5.3. Six alternatives were analyzed to determine the appropriate termination of the southbound (SB) HOV lane on I-75. Since the HOV is not environmentally cleared to be built south of M-102, the recommended SB terminus should end the HOV lane about 500 feet south of the I-696 structure and north of the I-696 entrance ramps. Benefits include:

- Entering traffic from I-696 would have an extended weave section to 9 Mile Road and HOVs destined to both 8 Mile and 9 Mile Roads would be exiting the lane just beyond I-696
- Improving enforceability since the HOV volumes south of I-696 are less and the likelihood of higher violation rates could occur
- Safer southbound operations in the curves between 8 Mile Road and 9 Mile Road, by ending the HOV just south of I-696, as it eliminates the weaving movements between the HOV and general purpose lanes

**Delineating HOV lanes** – Skip-dash pavement marking striping is recommended for transfer facilities (locations designated for ingress/egress from the HOV facility) with solid double pavement marking stripes between transfer facilities. This configuration should reduce the opportunities for violation.

**What constitutes an HOV vehicle** – 2+ occupancy is recommended as this is typically standard practice. The minimum occupancy requirement will need to be monitored to determine if 3+ is warranted. If the HOV lanes are getting too congested with the 2+ occupancy to provide at least one minute travel time savings per mile, then MDOT may need to implement a 3+ occupancy requirement. To encourage the use of fuel efficient vehicles, consideration should be given to allowing these types of vehicles in the HOV lanes with less than the required number of passengers. Public transit vehicles or privately operated buses and coaches carrying passengers, motorcycles, vanpools, and/or law enforcement and emergency vehicles can use the HOV lanes at all times.

**Operation** - Part-time operations are anticipated to be in both directions in both morning and evening peak periods, since there is not one peak commute direction. The operational restriction may change over time, but will at least initially include a restriction for a minimum 2-hour period in the AM and PM peak commute periods (i.e., 7-9 AM and 4-6 PM). The basis for the restriction should encompass exhibited periods of recurring congestion (speeds below 35 mph) for 85-percent of the observed commute periods. MDOT may have a different threshold associated with defined congestion and determination of operation periods once the project is ready to be opened. Changing operation hours does not constitute a “significant operational change” with respect to FHWA. However, any changes in

operation will affect corridor signing and need to be communicated with the public prior to such changes taking effect.

**Design Criteria** – A minimum 12-foot HOV lane and a full width shoulder (minimum 10 feet) is recommended on the left side of the HOV lane to allow for an area for enforcement and vehicle breakdowns.

**HOV Enforcement** - It is recommended that HOV enforcement be the responsibility of the agency responsible for that section of freeway. It is proposed that fines collected be directed towards the agency doing the enforcement to encourage their efforts. Fines should be sufficient enough to be a deterrent and escalate as a motorist incurs multiple violations. Roving patrols should be performed in the corridor unless there are violators in excess of 15-percent.

## *E3.3 Carpool Lots*

Carpool lots support HOV lane use by providing areas where drivers can form carpools and then be eligible to use the HOV lane. Implementation of expanded ITS holds the potential to encourage carpool formation and HOV lane use by informing motorists of the availability of carpool parking.

Recommendations regarding the potential for adding carpool lots came from the *Strategic Needs Plan for Metro Region Carpool Lots*, December 2009. Of the sites with good potential, only one is in the study corridor located at the I-75/I-696 interchange (I-75, Exit 61). There is available right-of-way (ROW) for development of a carpool lot in the northeast quadrant of this interchange to provide for a new carpool lot with approximately 100 spaces. This system-to-system interchange also has through-routed service drives that connect with one another and the surrounding surface streets. Land between the service drive and ramps in the northeast quadrant could be developed as part of the I-75 HOV project, which calls for reconstruction in this area. An entrance could be created across the northbound (NB) service drive from Dartmouth Street to minimize conflicts and maximize sight distance. See Section 5.4 for more details.

## *E3.4 Freeway Alignment*

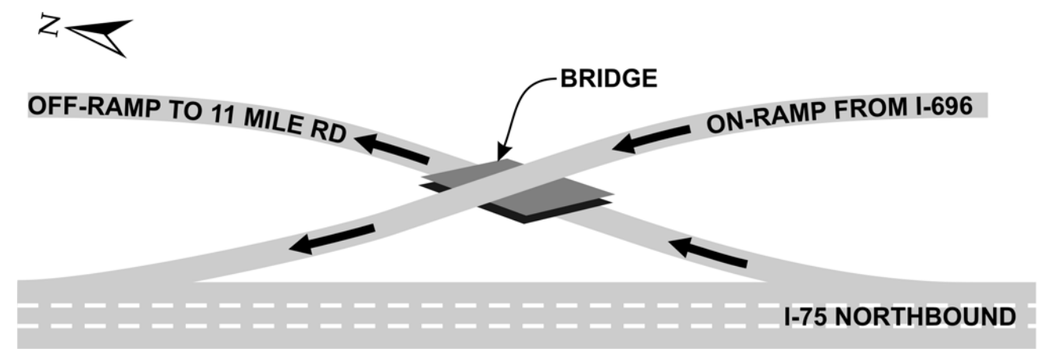
The reconstruction of the existing freeway, affected service drives, and ramps to current standards, plus adding an additional lane in each direction to function as an HOV lane, are the main elements of the project. Widening for the additional lanes will be to the outside, resulting in new retaining walls added throughout the majority of the corridor. Additional improvements include reconstruction and lengthening of existing retaining walls, new construction and replacement of sound walls and separation of freeway drainage from the existing combined sanitary/storm sewer outfall (CSO).

A new braided ramp design with a collector-distributor ramp configuration is proposed for the I-696 entrance ramp to NB I-75 and for the proposed slip ramp from NB I-75 to 11 Mile Road, resulting in the removal of the Dallas Avenue bridge due to its close proximity. The mechanics of a “braid” is to avoid the merging (weaving lane) of two separate roadways by introducing a structure to create a vertical difference which keeps the roadways separated but maintain the same course. Figure E-2 provides an example of the proposed I-696 to NB I-75/11 Mile Road braid.

The proposed geometry was designed to fit within the ROW established in the FEIS. In order to minimize impacts to local roads, the service drive elevations have been maintained. The median barrier location was preserved where possible. The design criteria used is located in Section 3.0.

The center of the four-lane section for each roadway serves as the point of rotation. Superelevation is obtained by rotating the pavement about this point. In straight sections where no superelevation is needed, the center of the roadway will be the crown point. The crown is the high point of the roadway with a cross slope downward towards both edges. All horizontal curves along NB and SB I-75 are superelevated according to current MDOT standard plans.

**Figure E-2 Example of the I-696 to NB I-75/11 Mile Road Braid**




The transition lengths needed for the roadway to rotate from a non-superelevated section to a superelevated section meet current MDOT standards, with the exception of the transition between the two reverse curves between the Gardenia Avenue bridge and the 12 Mile Road bridge. ROW constraints prohibit realignment of the mainline to meet current standards. The straight (tangent) length between these two curves is too short to use the MDOT standard, so a design exception will be necessary at this location for exceeding maximum rotation rate and has been coordinated with the project to the north.

**Horizontal Mainline I-75**

The outside back of curb of the NB and SB service drives served as constraints to limit the impact on local cities, crossroads, and residential driveways. The service drive horizontal and vertical alignments remained virtually the same as existing; however, the width was reduced where necessary to provide space for widening NB and SB I-75.

The freeway horizontal alignment consists of nine curves. Two curves did not meet a design speed of 75 mph and will require a design exception for radius; one meeting a 70 mph design speed and the other reaching a 65 mph design speed. These locations are:

- 9 Mile Rd Curve to the left at PI STA 730+75 (R=2042’, 70 mph)
- 9 Mile Rd Curve to the right at PI STA 756+26 (R=1647’, 65 mph)

To increase the design speed of these curves, each radius was increased and the tangent between the two curves lengthened for rotation. These improvements, coupled with an additional lane in each direction, forced the freeway alignment to vary from service drive alignments, reducing lateral separation between the service drive and the mainline pavement in several locations.

**Vertical Mainline I-75**

The corridor is a depressed freeway. A minimum of 14’9” of underclearance is maintained for I-75 under local roads south of the I-696 interchange and 16’3” north of I-696. The NB and SB service drive elevations have been maintained to limit the impacts to local roads. Therefore I-75 is required to be lowered to meet the vertical underclearance at the proposed structures. The proposed mainline vertical profile is on average three feet lower than the existing profile. A maximum cut depth of approximately ten feet occurs just north of Meyers Avenue where the horizontal alignment deviates from the existing

footprint. The area between 11 Mile Road and Gardenia Avenue is also being lowered to meet the vertical design speed of 75 mph.

The excavation required to widen and lower I-75 creates utility impacts throughout the corridor. See Section 5.11 for utility information. All possible variations were developed, yet the design speed of 75 mph could not be satisfied for the following curves:

- NB PVI 900+68.86 (70 mph) sag curve under Gardenia Avenue and Stephenson Highway Bridge
- SB PVI 901+45.51 (70 mph) sag curve under Gardenia Avenue and Stephenson Highway Bridge

These curves are constrained by the 12 Mile Road interchange, underclearance needs at the Gardenia Avenue and Stevenson Highway bridges, and the close proximity of these structures to each other.

The proposed typical sections and alignments for the corridor between M-102 to south of 12 Mile Road are detailed in plan sheets found in Appendix A.

## E3.5 Design Exceptions

Design criteria were created and set forth to meet both the current Michigan Department of Transportation standards and the Federal Highway Administration standards. This design criteria is detailed in Section 3.0. In some locations throughout the corridor, some of the criteria was unattainable due to physical and socioeconomic constraints, and ROW limitations.

Locations of design elements that have not met the required standard are documented in Section 5.9, Table 5-8, Design Exceptions. Each design exception has a list of the design elements that do not meet the standard, the location, the existing element design value, the proposed element design value, and the standard design value required. Each location also has a brief explanation of the cause for the design exception.

## E3.6 Drainage

The proposed storm drainage collection system for this section of I-75 mainline consists of seven separate drainage districts that convey stormwater via proposed pump stations to a proposed trunkline sewer under NB I-75. Details of the drainage study are provided in *Drainage Study, I-75, 8 Mile Road to 12 Mile Road, Engineering Report*, December 2009.

Construction of the storm sewer trunkline within the NB I-75 service drive will include consideration of existing utility conflicts, depth of excavation, and ROW impacts. In some locations, particularly between I-696 and 11 Mile Road, the storm sewer trunkline depths of excavation under the NB I-75 service drive approach 30 feet deep. For the deeper sections of storm sewer construction or where multiple significant utility conflicts are abundant, it may be cost effective to install the pipe by means of trenchless technology such as micro-tunneling. Once costs and impacts are fully understood for utility relocation work, a cost analysis should be conducted to determine the feasibility of any trenchless technology options versus traditional open-cut storm sewer installation.

**Red Run Drain Outfall Coordination**

The proposed NB I-75 service drive trunkline sewer exits the project boundaries just north of the Gardenia Pump Station and continues north and east to the Red Run Drain. Coordination occurred with the other project study area. It was determined that there are no fixed requirements regarding the amount of discharge the Red Run Drain can accept. This is based on the large ratio between the total contributing drainage areas of the Red Run Drain and the relatively smaller drainage areas of the project storm sewer trunkline. Further coordination and discussion with the Oakland County Drain Commission will be needed in the future.

## E3.7 Utilities

An investigation of the existing utilities and quality levels was conducted. A conflict list, found in Appendix C, was developed to distinguish public and private utilities that could be in conflict with the proposed construction. Potential conflicts could add cost and schedule delays to the project if not coordinated properly during the design phase. Since public utility relocation could add significant additional cost to the project, Subsurface Utility Engineering (S.U.E.) was added to improve the reliability of the public utility data. A priority list of twenty vacuum excavations was suggested for further exploration in the technical report.

Of the twenty vacuum excavations two were completed due to conflict with the reconstruction of the 9 Mile Road bridge in 2009. It is recommended that the remaining vacuum excavations be completed during future design.

The proposed storm sewer under I-75 NB service drive between 8 Mile Road and 12 Mile Road has two options for installation, open-cut or micro-tunneling. The tunneling method used would avoid most of the utility conflicts under the I-75 NB service drive compared to the open-cut method, which would require major relocation efforts.

## E3.8 Bridges and Structures

**Bridges**

Structure studies make recommendations for bridge type and size. Recommendations include: number of spans, span lengths, superstructure type, and foundation system. The structure design addressed the roadway profile requirements to provide the minimum required underclearance. Load Resistance Factor Design (LRFD) methodology was used.

The addition of a lane in each direction will require the bridges to be reconstructed in order to provide the appropriate shoulder and lane widths for the widened roadway. The proposed profile grades on the structures over I-75 will approximate the existing profile grades and required minimum underclearance will be provided by lowering the freeway. Raising the cross road profiles to increase underclearance is not possible due to the close proximity to the service road intersections. Any noticeable change in bridge profile would affect the approach section and require reconstruction of the service roads in that area.

The new bridges will be designed according to current American Association of State Highway and Transportation Officials (AASHTO) and MDOT standards and specifications. Along with accommodating the additional roadway width, the proposed structures and roadway will be designed to correct deficient underclearance and carry updated live loads. Six bridge groups were selected and examined based on span lengths, beam type, skew, and bridge function. Multiple beam types were examined for each of the bridge groups. Beam recommendations were based primarily on span length, but also considered future maintenance and cost. The preliminary geotechnical report anticipates differential settlement along the corridor due to soil material properties. Mechanically stabilized earth (MSE) walls were recommended for the abutments due to their lower cost when compared to full-height cast-in-place concrete cantilever walls and their ability to accommodate differential settlement. The superstructure configuration will provide safe, pedestrian access (sidewalks and fencing).

Two bridges along the corridor are expected to be removed, thus resulting in construction and future maintenance cost savings. Specifically, a braided ramp design results in the removal of the Dallas Avenue bridge. The U-Turn structure at 9 Mile Road will be combined with the U-Turn structure at John R Road and reconstructed as one double U-Turn structure.

The existing tri-level structures at the I-75/I-696 interchange will not have to be rebuilt to accommodate the lane addition. Table E-1 provides the structure summary table including information on existing and recommended proposed structures, as well as estimated cost.

**Table E-1 Structure Summary Table**

| CONSTRUCTION SEGMENT AND ANTICIPATED CONSTRUCTION START DATE | STRUCTURE NUMBER | PB STUDY GROUP | DESCRIPTION | EXISTING STRUCTURE | RECOMMENDED STRUCTURE | COMMENTS | 2009 ESTIMATED COST |
|---|---|---|---|---|---|---|---|
| Construction Segment 1 - 2026 (I-696 to 12 Mile Road) | S06 of 63103 | | I-75 under Dallas Double U-Turn | Two Span Steel Stringer Continuous Composite | | Structure Eliminated | $434,000 |
| | S33 of 63174 | Group 6 * | 11 Mile Road Exit Ramp under I-696 Ramp | N/A | Two Span Continuous Structural Steel Plate Girders (Braided Ramp) | New Structure | $4,197,000 |
| | S30 of 63174 | Group 2 | I-75 under 10 1/2 Mile Road | Two Span Steel Stringer Composite | Two Span Continuous, Skewed & ~90 Degrees, Type IV PCI Beams 54 | Reconstructed | $3,847,000 |
| | S31 of 63174 | Group 1 * | I-75 under 11 Mile Road | Four Span Steel Stringer Composite | Two Span Continuous, ~90 Degrees, Type III PCI Beams 45" | Reconstructed | $3,350,000 |
| | S01 of 63174 | Group 1 | I-75 under Gardenia Road | Two Span Steel Stringer Continuous | Two Span Continuous, ~90 Degrees, Type III PCI Beams 45" | Reconstructed | $2,301,000 |
| | S02 of 63174 | Group 4* | I-75 under NB Service Road | Two Span Steel Stringer Continuous | Two Span Continuous, Skewed, Structural Steel Plate Girders | Reconstructed | $2,126,000 |
| | | | | | | **Segment #1 Subtotal** | **$16,255,000** |
| Construction Segment 2 - 2028 (M-102 to I-696) | P02 of 63174 | Group 5 | I-75 under Bernhard Street Walkover | Fifeen Span Steel Girder & Floor Beam | Four Span Continuous, Structural Steel Plate Girders | Reconstructed | $2,030,000 |
| | S22 of 63174 | Group 2 * | I-75 under Meyers Avenue | Four Span Steel Stringer Composite | Two Span Continuous, Skewed & ~90 Degrees, Type IV PCI Beams 54 | Reconstructed | $1,909,000 |
| | P03 of 63174 | Group 5 * | I-75 under Harry Avenue Walkover | Fourteen Span Steel Girder & Floor Beam | Four Span Continuous, Structural Steel Plate Girders | Reconstructed | $2,144,000 |
| | P04 of 63174 | Group 5 | I-75 under Highland Avenue Walkover | Fourteen Span Steel Girder & Floor Beam | Four Span Continuous, Structural Steel Plate Girders | Reconstructed | $2,052,000 |
| | S23 of 63174 | Group 2 | I-75 under SB U-Turn at John R | Four Span Steel Stringer Composite | Two Span Continuous, Skewed & ~90 Degrees, Type IV PCI Beams 54 | Reconstructed | $1,554,000 |
| | S24 of 63174 | Group 2 | I-75 under John R | Four Span Steel Stringer Composite | Two Span Continuous, Skewed & ~90 Degrees, Type IV PCI Beams 54 | Reconstructed | $3,336,000 |
| | S25 of 63174 | Group 2 | I-75 under NB U-Turn at John R | Four Span Steel Stringer Composite | Two Span Continuous, Skewed & ~90 Degrees, Type IV PCI Beams 54 | Reconstructed | $2,700,000 |
| | S26 of 63174 | Group 2 | I-75 under SB U-Turn at 9 Mile Road | Four Span Steel Stringer Composite | Two Span Continuous, Skewed & ~90 Degrees, Type IV PCI Beams 54 | Combined with S25 | $166,000 |
| | S27 of 63174 | | I-75 under 9 Mile Road | Four Span Steel Stringer Composite | N/A | Rebuilt Fall 2009 | $0 |
| | P06 of 63174 | Group 5 | I-75 under Orchard Street Walkover | Fourteen Span Steel Girder & Floor Beam | Four Span Continuous, Structural Steel Plate Girders | Reconstructed | $1,866,000 |
| | S28 of 63174 | Group 2 | I-75 under Woodward Heights Boulevard | Two Span Steel Stringer Composite | Two Span Continuous, Skewed & ~90 Degrees, Type IV PCI Beams 54 | Reconstructed | $3,847,000 |
| | P05 of 63174 | Group 5 | I-75 under Browning Avenue Walkover | Fourteen Span Steel Girder & Floor Beam | Four Span Continuous, Structural Steel Plate Girders | Reconstructed | $1,908,000 |
| | S04 of 63103 | Group 3 * | I-75 under Shevlin Double U-Turn | Two Span Steel Stringer Plate Girder Composite | Two Span Continuous, ~ 90 Degrees, Michigan 1800 PCI Beams 71" | Reconstructed | $3,978,000 |
| | | * = Studied in Detail | | | | **Segment #2 Subtotal** | **$27,490,000** |

The structures within the I-696 Interchange; S05 of 63103, S16 of 63103, S17 of 63103, S18 of 63103 and S19 of 63103 will not require alteration for the addition of the HOV lane as studied in the Engineering Report.

**Retaining Walls**
The widening of the corridor will require cutting into the existing embankment slopes on each side of I-75. Subsequently, the exposed fill will need to be retained by a wall.

Many concepts were evaluated, refer to Appendix D. Various wall types and the issues associated with each wall type were evaluated for the corridor. This analysis considered four retaining wall types:

- Steel soldier pile wall
- Steel sheet pile wall
- Cast-in-place (CIP) or precast concrete cantilever wall
- Mechanically Stabilized Earth (MSE) walls

To recommend a retaining wall type, performance and risk, economy, constructability, maintenance, environmental impacts, and aesthetics were considered for each wall type. The two recommended walls for the corridor were the concrete cantilever (CIP or gravity) or MSE walls.

Cast-in-place or precast concrete cantilever retaining wall structures may be used throughout the corridor. In some locations it may be necessary to use temporary sheeting, temporary soldier pile walls, a reduced cantilever wall heel, or other methods to minimize the wall construction footprint and to minimize impacts to adjacent service drives, buildings, and other facilities. At some locations where a wall is required in front of a proposed bridge abutment, an MSE wall may be suitable.

Where wall heights exceed 30 feet, MSE walls or tied back concrete walls are proposed. The location of the proposed storm sewer under the adjacent service drive will need to be outside of the wall excavation limits or wall tiebacks. Where the maximum height is less than 8 feet, a cast-in-place concrete gravity wall is proposed. The braided ramp structure proposes to use MSE walls.

## *E3.9 Right-of-Way*

The ROW required was studied in the previous environmental phase and updated for this report. The ROW Report contained information regarding Tax ID numbers, addresses and the acreage needed for the proposed project. The communities involved in this segment are Hazel Park and Madison Heights.

Geometric adjustments have resulted in <u>less</u> ROW impacts than were indicated in the FEIS. Table E-2 provides a summary of east side and west side impacts along the freeway comparing the FEIS ROW impacts to the updated Engineering Report ROW impacts. Preliminary design refinement was able to reduce the number of parcel impacts by 18 on the east side and 4 on the west side, for a total of 22 reduced parcel impacts.

## *E3.10 Non-Motorized Facilities*

All of the existing pedestrian overpasses are being replaced approximately in their current location following the Americans with Disabilities Act (ADA) ramp criteria. These locations and ROW required are shown in Appendix E, Right-of-Way.

**Table E-2 Right-of-Way Summary from the FEIS through the Engineering Report Refinement**

| EAST SIDE ROW SUMMARY | FEIS | ENGINEERING REPORT REFINEMENT | REDUCTION |
|---|---|---|---|
| Number of Parcels | 62 | 44 | 18 |
| Total Area | 258,851 Square Feet | 223,885 Square Feet | 34,966 Square Feet |
| Acres | 5.942 Acres | 4.943 Acres | 0.999 Acres |
| **WEST SIDE ROW SUMMARY** | **FEIS** | **ENGINEERING REPORT REFINEMENT** | **REDUCTION** |
| Number of Parcels | 13 | 9 | 4 |
| Total Area | 20,420 Square Feet | 12,365 Square Feet | 8,055 Square Feet |
| Acres | 0.468 Acres | 0.284 Acres | 0.184 Acres |

## *E3.11 Corridor Construction Phasing*

Viable construction phasing was evaluated to provide a baseline for comparison of the conceptual MOT alternatives. Two methods have been identified for construction phasing that can be applied to separate projects into smaller, constructible contracts. The first method consists of separating the project into **segments**, performing all construction work in between established limits, as shown in Figure E-3. The second method separates the project into **components**, such as separating service drive and temporary freeway construction from the mainline freeway construction.

**Segment Construction**

Separation of the project into logical, constructible segments are driven by differences between existing and proposed horizontal alignments, grade differentials caused by profile or superelevation improvements, the need to provide positive drainage, and local access. Existing and proposed grades closely match, outside of superelevation areas, north of 13 Mile Road, south of 11 Mile Road, north of I-696, and south of 8 Mile Road that would facilitate crossover construction. In addition, the outlet of the proposed storm sewer is located at the Red Run Drain, just north of 12 Mile Road. If contracts are broken into segments, construction will need to start at this drainage outlet.

As a result, two construction contracts are feasible as described here and shown on Figure E-3.

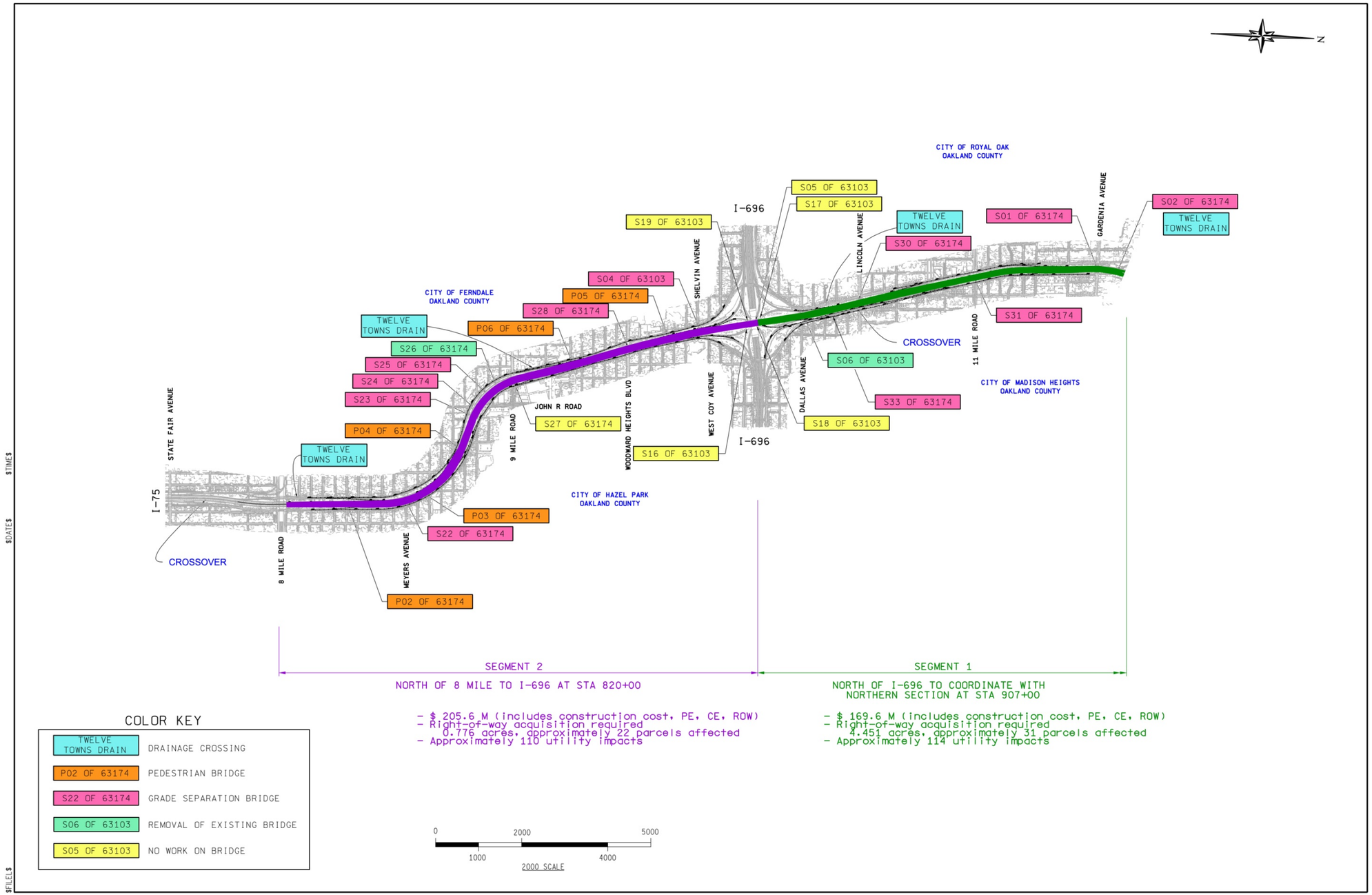
1. I-75 construction from north of 13 Mile Road to I-696 (I-75 STA 820+00)
2. I-75 construction from I-696 (I-75 STA 820+00) to 8 Mile Road

Segment construction would include all bridge, retaining wall, service drive, drainage, mainline and other miscellaneous construction work. Dependant on project funding, it may be possible to combine segments.

Combining segments had the following advantages/disadvantages:

1) Advantages - Construction can be completed more quickly at a reduced overall cost. Congestion reduction and safety improvements at the I-696 and 12 Mile Road interchanges would be realized with construction of the first contract. A drainage outlet would be provided for construction south of I-696. Project construction duration could be reduced.
2) Disadvantages - Smaller contractors may not be able to bid on the project and project financing may be difficult.

**Figure E-3 Project Vicinity Map and Construction Segments**



Keeping segments separated have the following advantages/disadvantages:

1) Advantages - Smaller contractors would be able to participate in the project bid process. Project financing would be easier.
2) Disadvantages - Multiple mobilizations and temporary mainline pavement at the crossovers of up to 500 feet will result in higher overall construction cost and longer construction duration.

**Component Construction**

Separation of the project into separate components that could be constructed independently is the second method of construction phasing. Components can be constructed as noted below:

- Advanced Service Drive and Drainage Construction - The NB and SB service drives from 8 Mile Road to north of Gardenia Avenue, along with retaining and noise abatement walls, could be built as a separate contract in advance of the freeway construction. This would include construction of the proposed storm sewer system along the NB service drives, to the outlet north of 12 Mile Road. Provisions need to be addressed to disconnect the freeway drainage system from the existing Combined Sewer Overflow (CSO) after the I-75 proposed storm sewer construction is complete. In addition, gaps in walls may be required to facilitate drainage and ramp construction. Several benefits derived from this advance construction work would be that new service drive pavement condition and signalization would be in place to better handle freeway spillover traffic, and the permanent drainage system for I-75 would be built and available in advance of the freeway pavement construction work.
- Advanced Freeway Temporary Construction - Temporary construction required to facilitate maintaining traffic on I-75 can be advanced. This work includes, but is not limited to, removal of the raised shoulders, curb and gutter, and median barrier, adjustment of existing drain castings, construction of shoulders flush with the pavement, and the placement of concrete barrier to separate median traffic.
- Advanced Staging of Bridge Construction- The required permanent underclearance is 14'-9" for crossover bridges south of I-696 and 16'-3" for crossover bridges north of I-696. MDOT and the FHWA have in the past approved temporary underclearance of 14'-0"minimum as work is being performed to bring bridge underclearance to standard upon construction completion. If a 14'-0" minimum underclearance is allowed during construction, bridges could be removed and replaced in advance of I-75 mainline construction work. This would mitigate impacts to local traffic that desires to cross the freeway during construction operations. A slight raise in crossroad profile grade, not impacting crossroad ROW, may be required. Bridge crossroad traffic could be maintained with part-width construction, or detoured if it is desired to construct the entire bridge over a shorter period of time. One lane in each direction would need to be closed in each direction on I-75, additional temporary underclearance advanced warning signing would be required on I-75, and off-peak short-term intermittent closures would be required on I-75 to remove and construct bridge beams.

  If MDOT or the FHWA does not approve a temporary bridge underclearance of 14'-0" minimum, then the bridges at Woodward Heights Boulevard, Shevlin Avenue Double U-Turn, Lincoln Avenue, 11 Mile Road, and Gardenia Avenue should not be advance constructed. The bridges would need to be constructed concurrent with the I-75 mainline.
- Construction I-75 Mainline – Construction of the mainline road, grading, drainage, signing, miscellaneous appurtenances, and bridges (if not advance constructed) would be the last component. This component can be separated into smaller limits consistent with the description in the segment section. For the purposes of the Maintenance of Traffic Technical Memorandum, it was determined to evaluate the entire project from north of 13 Mile Road to 8 Mile Road.

## *E3.12 Maintenance of Traffic (MOT)*

The maintenance of traffic section evaluates the design and constructability issues associated with the widening and reconstruction of the corridor. The existing southern section of I-75 from M-102 (8 Mile Road) to south of 12 Mile Road is a total length of 4.02 miles and consists of a six lane urban depressed freeway, with auxiliary lanes in each direction from north of 8 Mile Road to south of I-696, and from north of I-696 to 11 Mile Road. There are 20 bridges within this section, all of which serve local roads that carry vehicular or pedestrian traffic over the freeway. Service drives exist northbound and southbound along the freeway, connecting to the local roads via ramps at 8 Mile Road, 9 Mile Road, and 11 Mile Road. The most critical access in this section is at the interchange of I-75 and I-696, located between 9 Mile Road and 11 Mile Road. The existing drainage is maintained using an enclosed storm sewer system that outlets to the Red Run Drain north of 12 Mile Road.

The northern section of I-75 from south of 12 Mile to south of M-59 is a total length of 13.64 miles and consists of a six lane rural raised freeway with seven interchanges. There are 36 bridges in this section. Unlike the southern section, there are no service drives within this section and existing drainage is maintained using open ditches in the median and outside.

MOT concepts were developed for both sections, using the criteria set forth in the 2005 FEIS for the project and recent mobility criteria. The MOT concepts incorporate the proposed improvements while considering mobility and constructability as outlined in the MDOT policy for Transportation Management Plans (TMP's). Coordination of the MOT concepts between the two sections was performed to identify a seamless project that will integrate the two sections.

Several factors were considered when developing the various MOT conceptual alternatives and identifying the construction phasing of the corridor:

- Existing and proposed geometrics
- Bridge underclearance
- Drainage
- Freeway and local access for vehicular and non-motorized traffic

**MOTSIM Analysis.** A freeway network was developed to analyze traffic shifts that might occur from M-59 in the north, Woodward to the west, the Davison to the south, and Dequindre to the east. Modeling was performed to help assess three alternative scenarios:

1. Alternative 1 - Full closure of I-75
2. Alternative 2 - Two lanes maintained in each direction (Crossover or Part-Width Construction)
3. Alternative 3 - Three lanes maintained in each direction

**Develop Maintenance of Traffic Concepts.** The MOTSIM model was utilized for the three alternative scenarios to address the needs of the potential construction phasing and the impacts to maintenance of traffic. These MOT concepts incorporate the freeway improvements described in the project's geometric, bridge, retaining wall, drainage, and traffic studies.

A Technical Memorandum was prepared to identify constructability issues, viable staging, traffic operational impacts, and the advantages and disadvantages of each MOT conceptual alternative.

A decision matrix was generated and is included as Figure 5-25. Alternative 2 Crossover Construction and Alternative 3 have emerged as viable options for consideration and further analysis. The reasons that these Alternatives are being carried forward as the preferred concepts are:

- Alternative 1 mobility impacts were determined too intense and not favorable. Therefore this alternative was discarded from further consideration.
- Alternatives 2A (Part-Width) and 2B (Crossover) had similar mobility impacts. Traffic impacts considered both alternatives favorable. Alternative 2A is more difficult to construct than Alternative 2B, as there is more construction traffic intermixing with vehicular traffic. This intermixing could lead to safety concerns and potential crashes, related to speed differentials and potential of traffic slowdowns and stoppages that users may not anticipate. Since Alternative 2B does not have these concerns, but does provide the same user mobility benefits as Alternative 2A, Alternative 2B was recommended for further consideration as a preferred alternative and Alternative 2A was discarded from further consideration.
- Alternative 3 mobility impacts were low. This alternative does have similar constructability concerns as Alternative 2A, with construction traffic intermixing with vehicular traffic; however, maintaining an extra lane in each direction has minimal mobility impacts and tremendous economic savings to the user. Less congestion will reduce the potential of traffic slowdowns and stoppages that could reduce the overall potential of future crashes. Alternative 3 will cost more and take longer to construct than Alternative 2B, but the overall reduction of "mobility impacts" justifies that this alternative also be carried forward as a preferred alternative.
- Alternatives 2B and 3 each have advantages and disadvantages that will either benefit or impact stakeholders. A detailed description of all the alternatives is contained in Section 6 of the MOT Technical Memorandum, and a detailed description of the selection process is contained in Section 8. As stakeholder involvement increases as the project continues in development, it is recommended that these options be presented and a final be selected based on this additional input.

## *E3.13 Intelligent Transportation Systems (ITS) Initiatives and Strategies*

The I-75 corridor is a mature ITS deployment, with ITS devices that have been strategically placed to monitor roadway conditions and provide enhanced notification to the public. The critical segment of highway within the project limits contains a robust ITS infrastructure consisting of five Dynamic Message Signs (DMS), six Closed Circuit Television (CCTV) cameras, ten vehicle detection stations, and four environmental sensors. A combination of these ITS devices have recently been deployed in use with a curve/speed warning system approaching the 9 Mile Road curve.

The proposed construction will result in conflicts with the existing MDOT ITS infrastructure. Appendix H provides details about each identified conflict, such as the conduit, fiber and existing ITS devices that are installed on the freeway or service drive that will be directly impacted by the new alignment plan.

## *E3.14 Cost Estimates*

The cost estimate for this project was completed using standard MDOT estimating procedures. The unit cost items are a compilation of various MDOT pay item average unit prices. For the freeway, ramp, and local road work the MDOT "Weighted Average Item Price Cost Report" for 2009 was used. In addition, bid prices from recent construction projects were consulted and used to adjust some of the higher unit price items. Table E-3 shows the baseline cost estimate for the section of I-75, from 8 Mile Road to south of 12 Mile Road, in 2009, 2026, and 2030 dollars. In 2009 dollars, the total construction cost estimate is $324.6 million, and includes construction, utility, maintenance of traffic, structures, and property acquisition.

The corridor costs are also broken down by segment, see Table E-4. Segment 1 (north of I-696 to south of 12 Mile Road) is anticipated to cost $169.6 million. Segment 2 (north of M-102 to I-696) is anticipated to cost $205.6 million.

**Table E-3 Baseline Cost Estimate for I-75 from M-102 to South of 12 Mile Road**

| CONSTRUCTION COST (in millions) | *2009 DOLLARS* | *2026 DOLLARS* | *2030 DOLLARS* |
|---|---|---|---|
| | | (Using 4% inflation) | |
| **Segments 1 & 2** | | | |
| I-75 Mainline and Ramps | $181.2 | $353.0 | $412.9 |
| Roadway, Service Drives | $23.6 | $46.0 | $53.8 |
| *Subtotal* | **$204.8** | **$398.9** | **$466.7** |
| **Utility** | | | |
| *Subtotal* | **$11.9** | **$23.2** | **$27.1** |
| **Maintenance of Traffic** | | | |
| *Subtotal - (Alternative 3)* | **$19.7** | **$38.4** | **$44.9** |
| **Bridge** | | | |
| Bridges | $43.7 | $85.1 | $99.6 |
| Retaining Walls | $36.4 | $70.9 | $82.9 |
| *Subtotal* | **$80.1** | **$156.0** | **$182.5** |
| **Right of Way Acquistion** | | | |
| ROW east side of I-75 | $7.0 | $13.6 | $16.0 |
| ROW for pedestrian structures | $1.0 | $1.9 | $2.3 |
| ROW west side of I-75 | $0.1 | $0.2 | $0.2 |
| *Subtotal* | **$8.1** | **$15.8** | **$18.5** |
| **Total (excluding engineering costs)** | **$324.6** | **$632.3** | **$739.7** |

**Table E-4 Construction Costs by Construction Segment and Total**

| CONSTRUCTION SEGMENT | 2009 CONSTRUCTION COST | PRELIMINARY ENGINEERING | CONSTRUCTION ENGINEERING | ROW | TOTAL |
|---|---|---|---|---|---|
| Construction Segment 1 | $140,099,711 | $8,405,983 | $14,009,971 | $7,100,000 | $169,615,665 |
| Construction Segment 2 | $176,356,508 | $10,581,390 | $17,635,651 | $1,000,000 | $205,573,550 |
| | | | | **Total** | **$375,189,215** |

## *E3.15 Summary*

The reconstruction of the I-75 freeway from M-102 to south of 12 Mile Road will include the geometric upgrade of the freeway alignment and cross section within these limits. There are continuous service drives in the study corridor. There are 20 bridges within this section, all of which serve local roads that carry vehicular or pedestrian traffic over the freeway. The addition of a fourth (part-time HOV) lane impacts the horizontal and vertical alignments, geometrics, utilities, drainage impacts, ROW, structures, and noise abatement/retaining walls. The drainage for the corridor will be updated under the NB service drive with seven new pump stations.

The addition of a lane in each direction will require the bridges to be reconstructed in order to provide the appropriate shoulder and lane widths for the widened roadway. The proposed profile grades on the structures over I-75 will approximate the existing profile grades and required minimum underclearance will be provided by lowering the freeway. Raising the cross road profiles to increase underclearance is not possible due to the close proximity to the service road intersections. Any noticeable change in bridge profile would affect the approach section and require reconstruction of the service roads in that area.

Two bridges along the corridor are expected to be removed, thus resulting in construction and future maintenance cost savings. Specifically, a braided ramp design results in the removal of the Dallas Avenue bridge. The U-Turn structure at 9 Mile Road will be combined with the U-Turn structure at John R Road and reconstructed as one double U-Turn structure.

Included in the freeway reconstruction will be the installation of one carpool lot in the northeast quadrant of the I-75/I-696 interchange (I-75, Exit 61). The new carpool lot can provide approximately 100 spaces.

The project will impact 53 parcels for ROW acquisition. The ROW impacts are consistent with the areas listed in the FEIS. There are over 200 utility impacts, but no wetland impacts.

For project implementation, it is recommended the project be divided into two segments, with each project segment maintaining a construction cost estimate between $170 million to $206 million.

# 1.0 Introduction

I-75 is an interstate freeway that runs north-south from northern Michigan to southern Florida. It is a vital transportation corridor for the United States that also connects with other interstate freeways. This Engineering Report is a continuation of the original planning and engineering efforts conducted for development of the *Final Environmental Impact Statement, I-75 from M-102 to M-59, Oakland County, Michigan,* (FEIS) from 2005. The continued work is divided into two sections: the southern section extends from M-102 (8 Mile Road) to south of 12 Mile Road and is a depressed urban freeway section; the northern section extends from south of 12 Mile Road to south of M-59 and is an at-grade/elevated rural freeway section. Figure 1-1 provides an overview of the study area. This Engineering Report covers the southern section of I-75 from M-102 (8 Mile Road) to south of 12 Mile Road, which is approximately four miles in length and includes four interchanges and six local cross roads.

I-75 was built in the 1960s. It is the most traveled freeway in Michigan and is a gateway for travel north and south. In the study vicinity, I-75 parallels Woodward Avenue to the west, in a stair-step manner. It is used by many Oakland County residents and workers for intra-county/local trips. It connects Detroit and Flint and is an important corridor to businesses and residents alike. Studies have shown that the widening of I-75 is beneficial for the existing and future economic growth in the county.

The following paragraph from the Purpose and Need section of the FEIS accurately defines the benefits of the freeway segment:

> "The purpose of the proposed project is to increase the capacity of the transportation infrastructure in the I-75 corridor to meet travel demand for personal mobility and goods movement. Meeting the purpose of the project will improve motorist safety, travel efficiency, and reliability. These are essential both to personal mobility and to the movement of freight. I-75 will continue to play a role as a link in the nation's national system of Interstate and Defense Highways. I-75 connects Detroit and its international border crossings with the expanding economic development in Oakland County. Oakland County has the largest employment base of any county in Michigan and the most manufacturing plants, and is home to over 65 percent of the Detroit Metropolitan Statistical Areas major automotive equipment suppliers. I-75 also links the Southeast Michigan region with the rest of the state to the north. It is the sole means of high-speed freight movement to a large section of Michigan, as it is the only freeway that extends to the north state limit and freight rail coverage is limited."

The project need for increased corridor capacity is driven by growth that has occurred along I-75 since its construction. The needs for the proposed action are attributable to the following:

- Population and employment growth
- Existing traffic and level-of-service
- Future traffic and level-of-service
- Current design standards
- Physical condition and relative performance of I-75
- Safety
- Movement of goods and services

## *1.1 Study Area*

I-75 was built to the design standards of the time. In the nearly 50 years since the freeway was constructed, many improvements have been made, including additional interchanges and cross roads. The geometric improvements made to the freeway reflect the standards in existence at the time. This Engineering Report provides preliminary designs, estimates, and impacts to upgrade and provide additional capacity to the freeway.

This Engineering Report addresses access to the cities of Hazel Park, Ferndale, Madison Heights, and Royal Oak in Oakland County, Michigan. This area of I-75 experiences congestion during peak periods of the day that are projected to become more severe in the future with respect to intensity and duration. This section of I-75 has three lanes in each direction. An auxiliary lane, which is an additional lane between an entrance ramp and an exit ramp, exists between M-102 (8 Mile Road) and I-696.

The approximate four-mile study corridor includes reconstruction of the existing I-75 lanes and upgrade of all interchanges and service drives. The four interchanges with ramps are as follows:

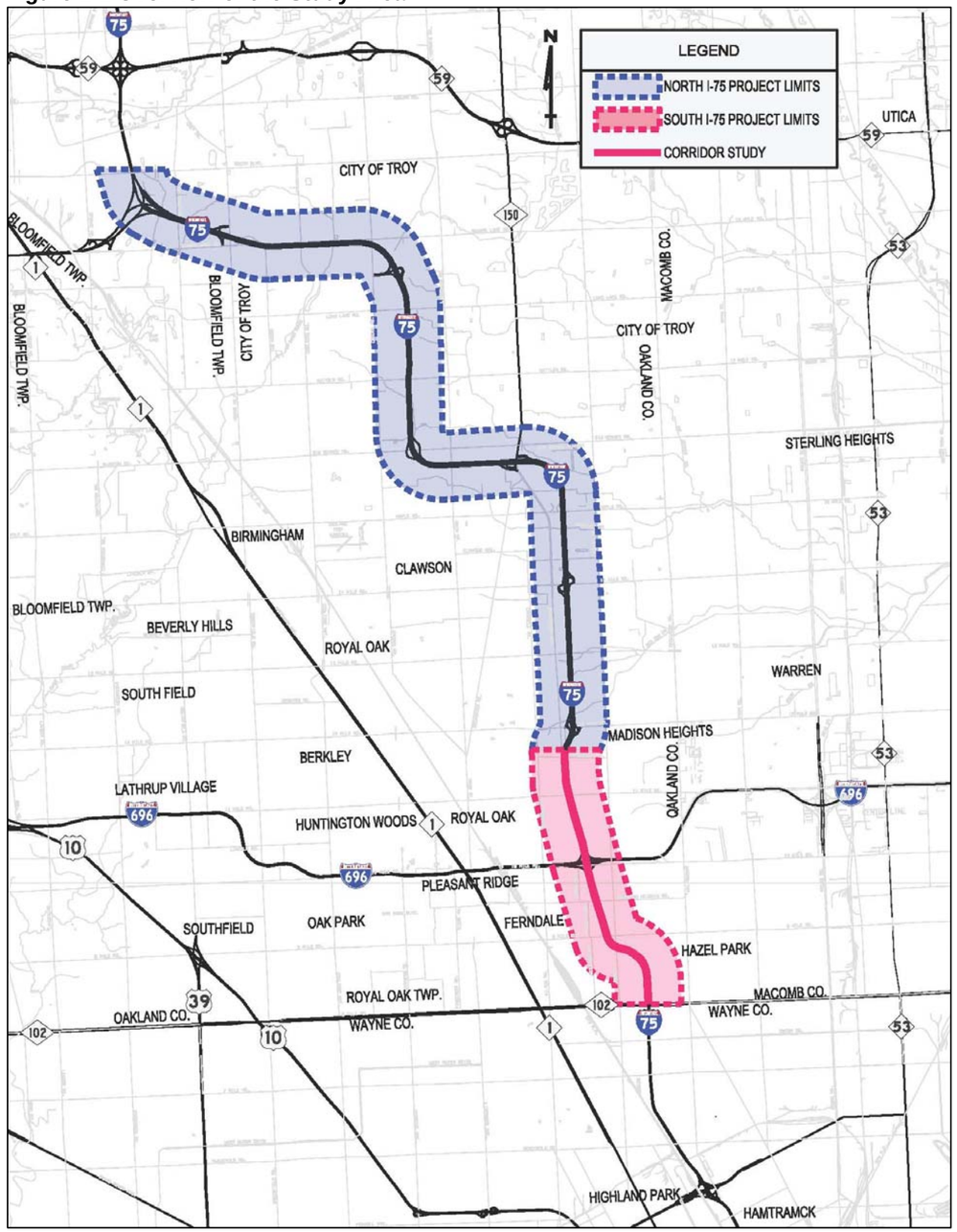
- 8 Mile Road (two northern ramps)
- 9 Mile/John R Road (9 Mile Road bridge was rebuilt in fall 2009)
- I-696
- 11 Mile Road

The six local roads that cross over the I-75 depressed freeway section are as follows:

- Meyers Avenue
- Woodward Heights Boulevard
- Shevlin Street/Coy Avenue
- Dallas Avenue
- Lincoln Avenue
- Gardenia Avenue

An overview of the study corridor, key structures, costs (construction, preliminary engineering, construction engineering, and right-of-way), construction segments, and key issues are shown on Figure 1-2, I-75 Vicinity Map.

**Figure 1-1 Overview of the Study Area**




## 1.2 Project Background

Since 1990, a number of studies have been conducted by the Michigan Department of Transportation (MDOT) recommending the need to add an additional lane on I-75 in each direction throughout Oakland County. This need has been identified in areas with less than four lanes in each direction due to the forecasted increased traffic volumes and development. Recommendations were made to improve the interchanges, arterial street system, and intelligent transportation system (ITS) network. Those studies led to the development and approval of the I-75 Environmental Impact Statement (EIS).

The development of the Final EIS (FEIS) for I-75 began in 2003, based on the need from prior studies. The *Final Environmental Impact Statement, I-75 from M-102 to M-59, Oakland County, Michigan,* was released in 2005. The FEIS recommended widening I-75 from three to four through lanes in each direction between M-102 and just south of M-59. The Preferred Alternative in the FEIS was to construct one lane in each direction between M-102 and South Boulevard. The additional lane would be limited to High-Occupancy Vehicles (HOV) during peak hours and would be a lane for general use during the remaining hours.

In the summer of 2009, a tanker fire caused the collapse of the 9 Mile Road bridge over I-75. In the fall of 2009, the 9 Mile Road bridge was rebuilt in the same location consistent with future recommendations. I-75 under 9 Mile Road was lowered to meet minimum required underclearance due to geometric improvements.

## 1.3 Project Scope and Engineering Report Organization

The project scope is to provide the Phase One Engineering Report. The work assessed the future reconstruction of this multi-lane urban freeway by adding a fourth lane in each direction for part-time HOV use.

Section 2: Existing Conditions—This section evaluates existing traffic operations and geometric configurations within the study area.

Section 3: Design Criteria—This section identifies the current design standards for each design element discussed in this study. The criteria adhere to the MDOT and American Association of State Highway and Transportation Officials (AASHTO) guidelines and are depicted in the tables provided in this section.

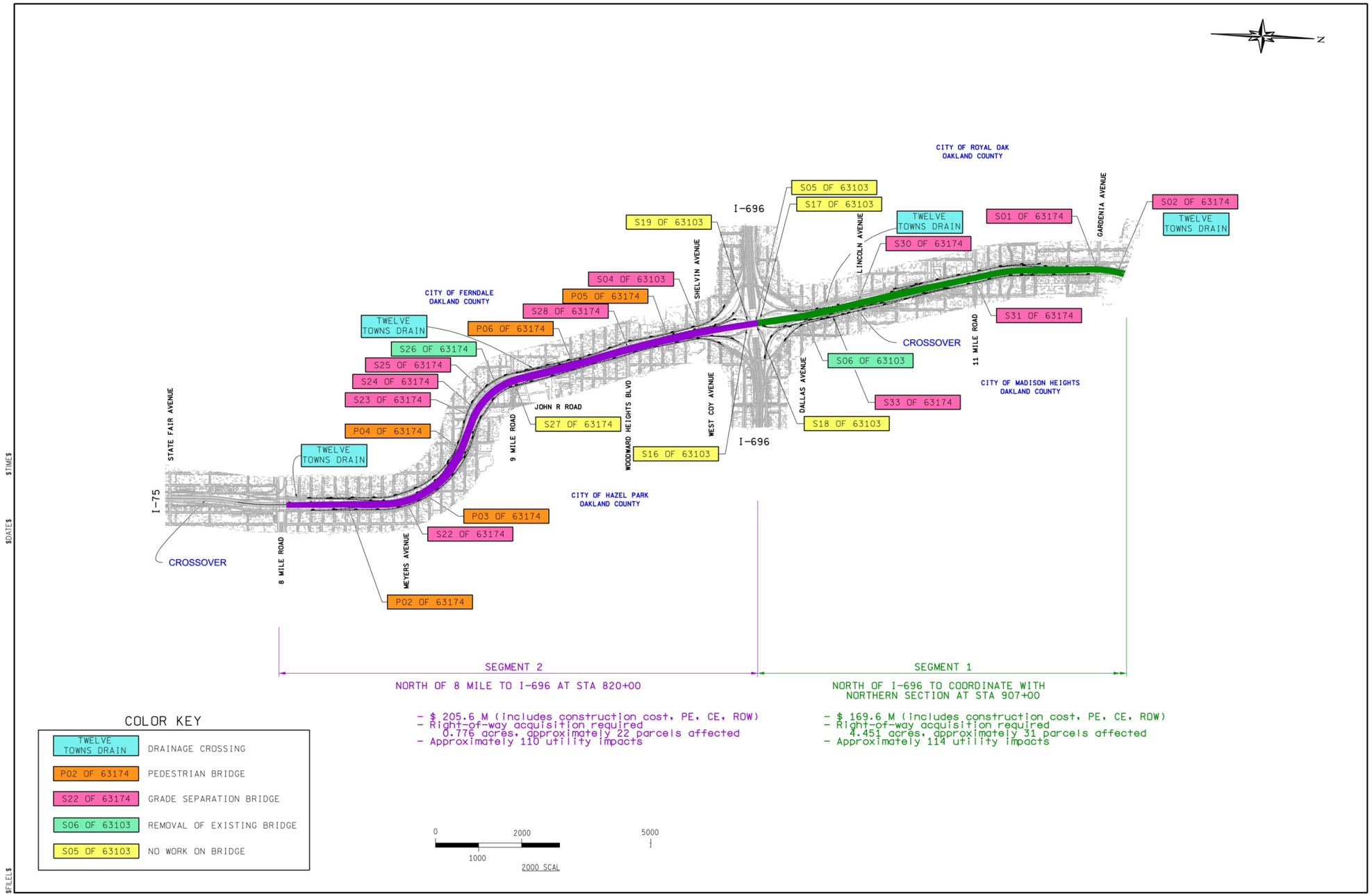
Section 4: Constructability Review—This section assesses constructability issues in the study area.

Section 5: Preliminary Design Analysis—This section describes and analyzes the geometrics, typical sections, design traffic volumes, design exceptions, HOV implementation and enforcement recommendations, drainage, geotechnical recommendations, utilities, bridges and structures, right-of-way, maintenance of traffic, non-motorized facilities, updates to environmental impacts, and cost estimates throughout the study area.

Section 6: Agency Coordination—This section addresses any documented agency coordination.

Section 7: Project Implementation—This section summarizes project phasing, funding, utility coordination, value engineering, and environmental commitments.

**Figure 1-2 I-75 Vicinity Map**



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# 2.0 Existing Conditions

This section describes the existing I-75 corridor from M-102 to south of 12 Mile Road, including crash data, geometrics (typical sections, as well as horizontal and vertical alignment), drainage, right-of-way, geotechnical conditions, bridges, utilities, and non-motorized facilities. Data from the Final Environmental Impact Statement (FEIS), as well as updates since the FEIS, were used to provide an understanding of the corridor.

## *2.1 Traffic Conditions and Crash Data*

The I-75 corridor from M-102 (8 Mile Road) to 12 Mile Road was studied in November 2003 using traffic data from 2002. The traffic conditions are documented in the *Final Environmental Impact Statement*, *I-75 from M-102 to M-59, Oakland County, Michigan*, for the Michigan Department of Transportation, April 2005. The level-of-service (LOS) is a standard measure that reflects the degree of congestion and amount of delay experienced by motorists. LOS is expressed as a letter between A and F. LOS A represents a situation where motorists experience minimal congestion, minimal delays, and free-flow traffic conditions. LOS F represents a situation where motorists experience extreme congestion, long delays, and severely impeded traffic flows.

Existing LOS for the I-75 corridor ranges from LOS C to LOS F (Table 2-1)

Generally, LOS D is deemed as the lowest acceptable LOS, except in urban areas such as I-75, where LOS E can be acceptable in peak hours of travel. The only area that has an unacceptable LOS extends from 11 Mile Road to 12 Mile Road in both peak hours for both the northbound and southbound directions.

**Table 2-1 Existing (2002) Peak Hour Traffic Volumes and Level- of- Service for I-75 Freeway Segments**

| SEGMENT | AM PEAK HOUR | | | | PM PEAK HOUR | | | |
|---|---|---|---|---|---|---|---|---|
| | VOLUME | | LOS | | VOLUME | | LOS | |
| | NB | SB | NB | SB | NB | SB | NB | SB |
| 8 Mile Road to 9 Mile Road | 4,030 | 5,260 | C | C | 5,850 | 5,370 | D | D |
| 9 Mile Road to I-696 | 4,670 | 5,600 | C | D | 6,220 | 6,060 | D | D |
| I-696 to 11 Mile Road | 4,670 | 6,000 | C | E | 6,300 | 6,080 | D | E |
| 11 Mile Road to 12 Mile Road | 5,210 | 4,800 | F | F | 5,900 | 5,050 | F | F |

Source: Final Environmental Impact Statement, I-75 from M-102 to M-59, Oakland County, Michigan, April 2005
NB = northbound; SB = southbound; LOS = level of service

In 2003, the traffic analysis compiled existing conditions crash data and established a list of countermeasures to assist with crash reduction. Crash data were obtained through the Southeast Michigan Council of Governments (SEMCOG) and Michigan Geographic Framework (MGF) for the years 1995 through 2001. The I-75 corridor was divided into smaller segments to determine crash rates (Table 2-2).

**Table 2-2 I-75 Existing Crash Data by Segment 1995-2001**

| SEGMENT | EXISTING AADT | CRASHES * | |
|---|---|---|---|
| | | NB | SB |
| 8 Mile Road to South of 9 Mile Road | 173,000 | 0.93 | 1.22 |
| South of 9 Mile Road to South of I-696 | 182,000 | 2.51 | 1.45 |
| South of I-696 to North of I-696 | 185,000 | 2.44 | 1.41 |
| North of I-696 to South of 12 Mile Road | 187,000 | 2.02 | 1.25 |
| South of 12 Mile Road to North of 12 Mile Road | 186,000 | 1.60 | 1.40 |

Source: Final Environmental Impact Statement, I-75 from M-102 to M-59, Oakland County, Michigan, April 2005
NB=northbound; SB = southbound
AADT = Average Annual Daily Traffic
* Crashes per million vehicle miles

According to the *I-75 Oakland County, Planning Study/Crash Analysis* the average crash rate for the entire I-75 corridor, from M-102 to M-59 was 1.31 crashes per million vehicles in 2001. Crash rates for all urban freeways in Michigan were 1.77 crashes per million vehicles. Three out of the five segments from M-102 to south of 12 Mile Road fall within the critical range and were evaluated to determine if countermeasures could improve safety. Possible countermeasures include superelevation improvements, additional lanes, lengthening entrance ramps and providing parallel-style exits ramps, improving sight distance, drainage, horizontal curve flattening, and improve sag/vertical curves. Detailed analyses of the countermeasures can be found in the *I-75 Oakland County, Planning Study/Crash Analysis*. These countermeasures were reviewed to improve the design for this Engineering Report.

## *2.2 Typical Sections*

The study corridor was originally built in the 1960s as a depressed freeway. Reconstruction and upgrades have been made within the existing freeway footprint.

I-75 consists primarily as a six-lane freeway (three northbound lanes and three southbound lanes) and becomes an eight-lane freeway (three northbound lanes with an auxiliary lane and three southbound lanes with an auxiliary lane) from M-102 (8 Mile Road) to 12 Mile Road. There are four interchanges with ramps throughout the four mile study corridor:

- 8 Mile Road (two northern ramps)
- 9 Mile/John R Road
- I-696
- 11 Mile Road

Three out of the four interchanges (8 Mile, 9 Mile, and 11 Mile Road) have urban slip ramp designs. The slip ramp consists of a 12-foot ramp lane with curb and gutter and shoulders. The I-696 interchange has a 12-foot standard freeway ramp with shoulders.

The four mile study corridor contains six local cross roads:

- Meyers Avenue
- Woodward Heights Boulevard
- Shevlin Street/Coy Avenue
- Dallas Avenue
- Lincoln Avenue

- Gardenia Avenue

The existing I-75 cross sections consist of six main sections (see Engineering Report, Appendix A). The existing section consists of three 12-foot lanes (with curb and gutter), some sections have an additional 12-foot lane as an auxiliary lane, a 10-foot outside shoulder, and a 9.16-foot median shoulder with concrete barrier. I-75 also consists of a northbound and southbound service drive traveling along the outside of the depressed freeway that is separated by a retaining wall with a 1-on-2 side slope. The service drive section consists of two 15-foot lanes (with curb and gutter), an 8-foot inside shoulder, and a 7.33-foot outside area containing a 5-foot sidewalk. Figure 2-1 provides the existing typical section for I-75 with three lanes plus an auxiliary lane in each direction with ramps and service drives.

## 2.3 Horizontal Alignment

The existing geometric conditions were evaluated based on current AASHTO and MDOT geometric standards (see Section 3.0, Design Criteria). I-75 consists of eight horizontal curves (see Engineering Report, Appendix A) ranging from 1,286.74 feet to 28,482 feet in radii and superelevations ranging from normal crown to a maximum superelevation of 7%. Three of the eight existing curves do not meet current standards for a 75 mph design speed (MDOT R-107 minimum radius = 2,344 feet for 7% superelevation). The three substandard horizontal curves, with design speeds less than 75 mph are as follows:

- Northbound I-75 at 9 Mile Road (7% existing superelevation with radius = 1,286.74 feet)
- Northbound I-75 at Gardenia Avenue (6% existing superelevation with radius = 1,909.90 feet)
- I-75 at Meyers Avenue (5% existing superelevation with radius = 2,178.50 feet)

The existing interchanges at 8 Mile, 9 Mile, and 11 Mile Roads all have an urban slip ramp design. They do not meet current MDOT geometric standards. The I-696 interchange has a standard freeway ramp alignment and layout.

In July 2009, the bridge at 9 Mile Road over I-75 collapsed due to a traffic crash involving a gasoline tanker truck. The bridge over 9 Mile Road was replaced in its current alignment and the section of freeway near the bridge was replaced to satisfy superelevation criteria. The horizontal curvature of the freeway in this area was not changed.

## 2.4 Vertical Alignment

The existing vertical conditions were evaluated based on current AASHTO and MDOT vertical standards (see Section 3.0, Design Criteria). I-75's vertical alignment consists of rolling terrain in a depressed freeway section. The slopes in the terrain range from approximately 0.30% to 3.00% in the sag and crest conditions. The elevations range from approximately 50 feet from the highest crest to the lowest sag vertical curve for the I-75 study corridor. The existing vertical clearance values for the overpass bridges are provided in Table 2-4. For more information on the vertical alignment, see the Engineering Report, Appendix A.

Due to the 9 Mile Road crash, the freeway vertical alignment was altered and modifications were made to the profile to satisfy current superelevation and bridge underclearance standards.

## 2.5 Drainage

The drainage analysis builds on the previous drainage study. The corridor has been evaluated for impacts to the proposed drainage and provides further analysis of the storm sewer trunkline proposed on the northbound I-75 Service Drive.

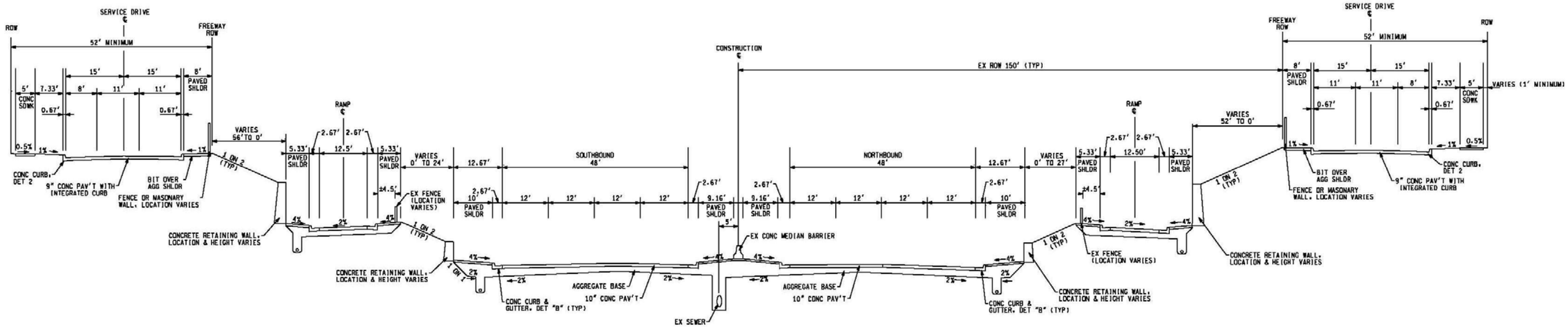
This study corridor of I-75 is a depressed freeway and has seven existing pump stations along the southbound I-75 lanes that raise stormwater into the Twelve Towns Drain sewer. The Twelve Towns Drain outlets to the Twelve Towns Drain Retention Treatment Facility (RTF) prior to ultimate discharge at the Red Run Drain.

The 2003 drainage study recommended separating I-75 stormwater from the Twelve Towns Drain sewer system to reduce flows to the Twelve Towns RTF and ultimately improve the quality of discharge to the Red Run Drain. A new storm sewer trunkline would be constructed starting at 8 Mile Road that would flow north toward 12 Mile Road. It would then head east, paralleling the RTF to the outlet at the Red Run Drain east of Dequindre Road. Since the large Twelve Towns Drain is under the southbound (SB) I-75 Service Drive, the proposed I-75 storm sewer trunkline would be under the northbound (NB) I-75 Service Drive. New pump stations would be constructed along NB I-75 to replace the seven existing pump stations along SB I-75. The proposed pump stations would collect flow from the depressed freeway and pump it up to the proposed NB I-75 storm sewer trunkline.

## 2.6 Right-of-Way

The right-of-way (ROW) required was assessed in previous study phases and updated for this Engineering Report. The ROW Report contained information regarding Tax ID numbers, addresses, and the acreage needed for the project. The communities impacted by potential ROW needs are Hazel Park and Madison Heights.

**Figure 2-1 Existing Typical Section for I-75 with Three Lanes plus an Auxiliary Lane in Each Direction with Ramps and Service Drives**



## 2.7 Geotechnical Assessment

The geotechnical assessment included a roadway and structural assessment. The geotechnical assessment summarized existing data, as well as new borings. Separate roadway and structure geotechnical reports were prepared.

**Roadway Investigation**

The geotechnical roadway investigation consisted of performing thirty-four (34) soil borings, as shown in Figure 2-2. The borings were performed on the I-75 northbound and southbound lanes and shoulders and on the ramps leading to and from I-75, including two of the ramps at the I-75/I-696 interchange. Generally, the lane borings (designated as B-xx) were laid out in such a way to alternate between the fast and the slow lanes by an interval of approximately 3,000 feet. The shoulder borings (designated as SB-xx) were generally laid out about every 6,000 feet on the outside shoulder. Ramp borings (designated as RB-xx) were performed in the asphalt-covered pavements of the ramps within the project limits. In total, 14 lane borings, 6 shoulder borings, and 14 ramp borings were taken. Cores were performed through the pavement at the surface of all the borings. All the soil borings extended to a depth of 10 feet below existing I-75 grades and performed in April and May 2009. Representative cohesive soil samples were subjected to laboratory tests that consisted of moisture content determinations and hand penetrometer tests. All samples were classified in general accordance with the Unified Soil Classification System. The results of the laboratory tests on respective logs for the test borings are included in the *Data Report on Geotechnical Investigation, I-75 EPE Study for the Roadway Pavement from 8 Mile Road to South of 12 Mile Road, Oakland County, Michigan, CS: 63174 – JN: 45700*, Appendix B, February 1, 2010. Photographs of the cores are provided in Appendix E of the technical report.

Grain size analyses were performed in accordance with MTM 108-97 and 109-97 on seventeen (17) selected samples of base materials to evaluate general conformance with MDOT Class II/III gradation requirements. Based on the 17 tested samples, 94% and 65% of the samples met the required gradation for Class III and Class IIA, respectively. Table 2-3 presents the grain size analysis results for the tested soil samples. Detailed results of the grain size analyses are included in Appendix C of the technical report. All laboratory tests were performed in general accordance with applicable ASTM and MTM procedures.

Groundwater was reported during drilling in 12 of the 34 borings, at depths ranging from 2 to 7 feet below the roadway surface, and in 7 of the 34 borings upon completion of drilling, at depths ranging from 7 to 10 feet below the roadway surface. Based on soils information from these borings and experience with similar soil conditions, it is expected that the long-term groundwater level is at a depth ranging between 2 to 5.5 feet below existing grades. Moreover, perched groundwater was encountered in granular sand fill soils at borings B-02, B-03, B-05, B-10 B-12, B-13, B-14, RB-09, SB-03, and SB-07.

It is believed that long-term groundwater is higher than the existing ground surface elevations at the depressed section of the freeway and that lowering of the groundwater table is most likely due to the existing drainage system for this section.

**Structure Investigation**

For this preliminary report, no additional geotechnical investigation was performed. The analysis and recommendations were based on two sources of soil information from earlier geotechnical investigations:

- *Geotechnical Investigation* performed in May 2003 for the I-75 Early Preliminary Engineering Study from 8 Mile Road to M-59 (MDOT J.N. 55776 – C.S. 63174). The preliminary study was performed to aid in the geotechnical investigation for the construction of retaining walls along I-75 to facilitate the proposed widening. In this Engineering Report, the relevant soil borings will be referred to as the 2003 borings.
- *Geotechnical Investigation* performed during the 1960s by the Michigan State Highway Department (MDSH) which is currently known as the Michigan Department of Transportation (MDOT). The geotechnical investigation was performed to aid in the new construction of the existing 24 bridges along I-75 between M-102 (8 Mile Road) to south 12 Mile Road, including the I-696 bridge and ramps. Available soil logs were evaluated and correlation methods were adapted to interpret the data in light of current design practices.

The field explorations performed in 2003 and in the 1960s consisted of 19 and 126 soil borings, respectively. The 2003 borings ranged in depth from 20 to 110 feet below the existing grades of the service drives or the I-75 grades. The 1960s borings ranged in depth from 31 to 127 feet below preconstruction grades.

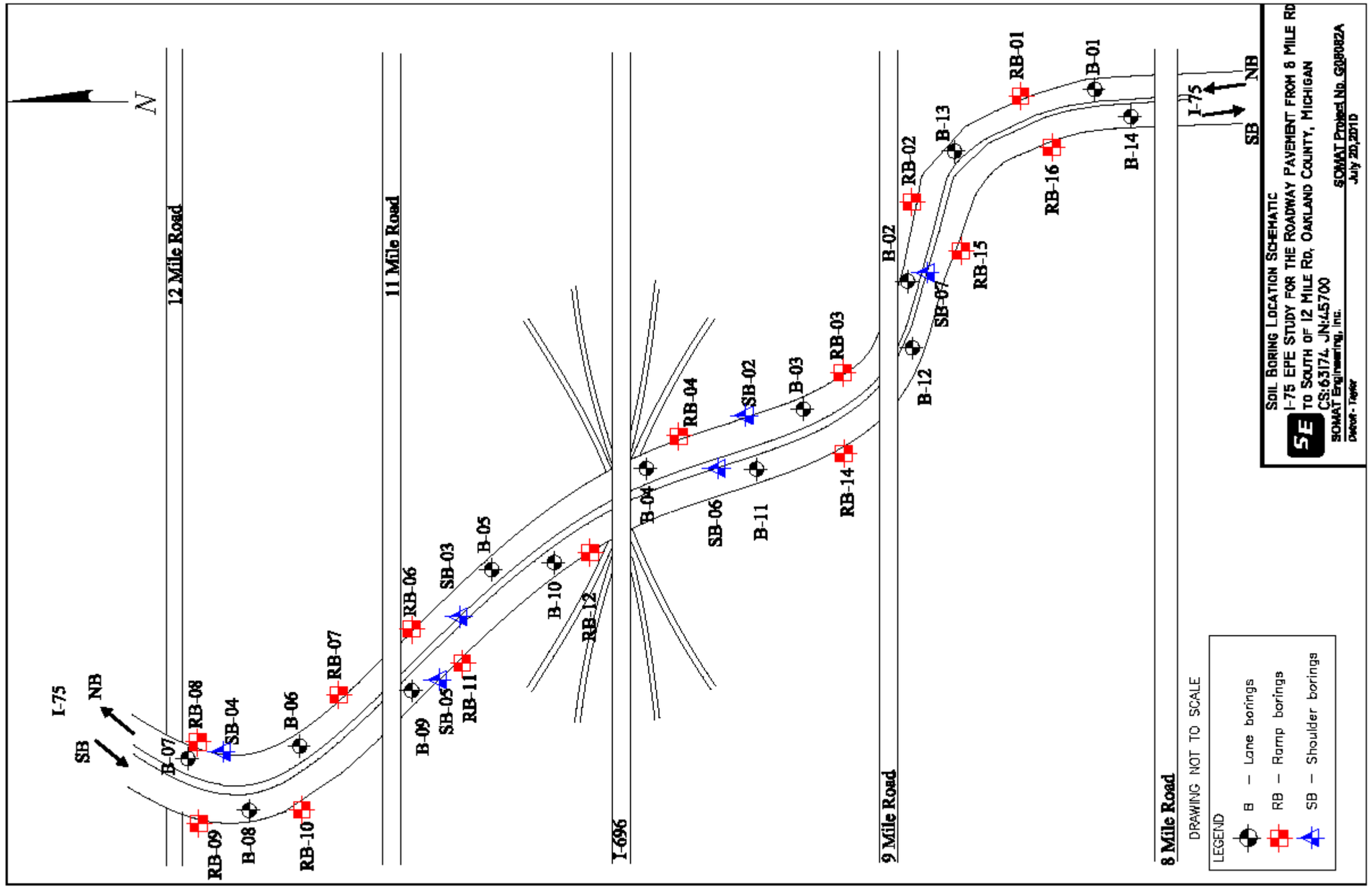
Below the variable surficial materials (pavement and granular fill soils), general soil conditions consisted of sand and silt. No organic content was reported in any of the 2003 borings. Other soil conditions encountered are very stiff to hard clay, stiff to medium clay, hard clay, compact sand, and apparent bedrock.

Based on the 1960s geotechnical investigation, it is estimated that the natural long-term groundwater level of the site from M-102 (8 Mile Road) to south of 12 Mile Road was at elevations ranging from about 621 feet to 607 feet. However, based on the 2003 geotechnical investigation, the actual groundwater level of this depressed section of I-75 ranged from about elevation 613 feet to 605 feet. The lowering of the groundwater table is most likely due to the existing drainage system for the depressed section of the freeway.

**Table 2-3 Grain Size Analysis Results for I-75 Granular Samples**

| Sieve Sizes | % Passing By Weight | | | | | |
|---|---|---|---|---|---|---|
| | 3 inch | 1 inch | 3/8 inch | No. 8 | No. 100 | <No. 200 |
| Results of Grain Size Analyses | | | | | | |
| B-01 | 100 | 100 | 89 | 67 | 17 | 12 |
| B-02 | 100 | 100 | 88 | 69 | 15 | 11 |
| B-04 | 100 | 100 | 92 | 70 | 13 | 9 |
| B-05 | 100 | 100 | 85 | 57 | 12 | 9 |
| B-07 | 100 | 100 | 92 | 75 | 11 | 8 |
| B-09 | 100 | 100 | 89 | 77 | 18 | 9 |
| SB-03 (Bulk base material) | 100 | 100 | 85 | 62 | 12 | 9 |
| SB-03 (Bulk subbase material) | 100 | 100 | 98 | 84 | 19 | 10 |
| SB-04 | 100 | 100 | 85 | 65 | 11 | 7 |
| SB-05 | 100 | 100 | 94 | 80 | 23 | 12 |
| SB-06 | 100 | 80 | 74 | 64 | 21 | 14 |
| SB-07 | 100 | 100 | 93 | 80 | 8 | 5 |
| RB-02 | 100 | 100 | 94 | 76 | 20 | 13 |
| RB-06 | 100 | 100 | 91 | 76 | 14 | 8 |
| RB-09 | 100 | 100 | 87 | 65 | 11 | 8 |
| RB-11 | 100 | 100 | 90 | 69 | 31 | 26 |
| RB-14 | 100 | 100 | 88 | 73 | 13 | 9 |

**Figure 2-2 Soil Boring Locations**



## 2.8 Utilities

An investigation of existing utilities was conducted to identify public and private utilities that could add cost or time delays to the project. All of the information for the existing utilities was developed into a utility plan set (Appendix C) that shows the proposed planned construction with existing utility locations. Existing utility information was compiled using existing plans (as-builts), subsurface utility engineering, topographic survey, and information provided by private and public utility companies.

The public utilities are as follows:

- City of Hazel Park
- City of Detroit
- City of Royal Oak
- City of Madison Heights
- Oakland County Water Resources Commission (formerly Oakland County Drain Commission)
- MDOT
- ITC

The private utility companies are as follows:

- AT&T
- Detroit Edison
- Comcast
- Verizon
- Consumers Energy

## 2.9 Bridges and Structures

**Bridges**

The majority of the bridges were built in the mid to late 1960s and early 1970s. In 2009, a petroleum tanker fire beneath the 9 Mile Road bridge over I-75 caused its collapse. The entire bridge was demolished and rebuilt later that year. The new bridge was designed and built to accommodate the addition of high-occupancy vehicle (HOV) lanes and to fit the I-75 future horizontal alignment. For a summary of the existing bridges, refer to Table 2-4. The information in this table was obtained from *MDOT Report No. 44, State Highway Bridges, Culverts and Grade Separations*. The *Bridge Concept Study,* March 2010 contains proposed and existing bridge plans for each replacement grouping.

**Retaining Walls**

Retaining walls were constructed in cut sections in the 1960s and are adjacent to most of the crossover bridges. Existing earth-retaining structures consist of cast-in-place concrete cantilever walls supported by spread footings. The *Retaining Wall Concept Study* included in Appendix D contains further information on existing walls, including details and locations.

## 2.10 Non-Motorized Facilities

Five pedestrian bridges (walkovers) provide pedestrians with access across the freeway. They are as follows:

- Bernhard Street Walkover
- Harry Avenue Walkover
- Highland Avenue Walkover
- Orchard Street Walkover
- Browning Avenue Walkover

All bridges would need to be replaced to accommodate the addition of HOV lanes and to conform to the Americans with Disabilities Act (ADA). Table 2-5 details the characteristics of the pedestrian bridges. All sidewalks are to maintain their existing width.

**Table 2-4 Existing Bridges**

| STRUCTURE ID | FACILITY CARRIED | LOCATION | NO. of SPANS / TOTAL LENGTH (feet) | STRUCTURE TYPE MAIN | STRUCTURE TYPE APPROACH | LANES ON BRIDGE / LANES UNDER BRIDGE | DECK WIDTH (feet) / HORIZONTAL CLEARANCE (feet) | VERTICAL CLEARANCE | DESIGN LOAD | YEAR BUILT / RECONSTRUCTED |
|---|---|---|---|---|---|---|---|---|---|---|
| P02 of 63174 | Bernhard Street Walkover | Hazel Park | 15 | Steel Girder & Floor Beam | Concrete Continuous Slab | 0 | 8.86' | 14'-11" L 14'-6" R | Pedestrian | 1966 |
| | | | 507 | | | 8 | 82.7' L 78.1' R | | | |
| S22 of 63174 | Meyers Avenue | Hazel Park | 4 | Steel Stringer Composite | | 2 | 42.32' | 16'-0" L 14'-10" R | H15 | 1966 |
| | | | 230 | | | 8 | 72.2' L 72.2' R | | | |
| P03 of 63174 | Harry Avenue Walkover | Hazel Park | 14 | Steel Girder & Floor Beam | Concrete Continuous Slab | 0 | 8.86' | 14'-8" L 14'-9" R | Pedestrian | 1966 |
| | | | 509 | | | 8 | 73.2' L 73.2' R | | | |
| P04 of 63174 | Highland Avenue Walkover | Hazel Park | 14 | Steel Girder & Floor Beam | Concrete Continuous Slab | 0 | 8.86' | 14'-11" L 14'-0" R | Pedestrian | 1966 |
| | | | 511 | | | 8 | 73.2' L 73.2' R | | | |
| S23 of 63174 | Southbound U Turn at John R Road | Hazel Park | 4 | Steel Stringer Composite | | 1 | 23.29' | 15'-0" L 16'-0" R | H20 | 1966 |
| | | | 223 | | | 8 | 72.2' L 72.2' R | | | |
| S24 of 63174 | John R Road | Hazel Park | 4 | Steel Stringer Composite | | 4 | 66.27' | 15'-2" L 16'-0" R | H20 | 1966 |
| | | | 260 | | | 8 | 71.2' L 71.9' R | | | |
| S25 of 63174 | Northbound U Turn at John R Road | Hazel Park | 4 | Steel Stringer Composite | | 1 | 23.29' | 14'-4" L 16'-0" R | H20 | 1966 |
| | | | 216 | | | 8 | 72.2' L 72.2' R | | | |
| S26 of 63174 | Southbound U Turn at 9 Mile Road | Hazel Park | 4 | Steel Stringer Composite | | 1 | 23.29' | 14'-8" L 16'-0" R | H20 | 1966 |
| | | | 221 | | | 8 | 72.2' L 72.2' R | | | |
| S27 of 63174 | 9 Mile Road | Hazel Park | 4 | Steel Stringer Composite | | 5 | 66.27' | 17'-0" L 14'-6" R | H20 | 1966 |
| | | | 224 | | | 8 | 71.9' L 71.9' R | | | |
| | | | 2 | Steel Stringer Composite | | 5 | 73.08' | 14'-6" R | HL-93 Mod | 2009 |
| | | | 198 | | | 8 | 70.6' L 70.6' R | | | |
| P06 of 63174 | Orchard Street Walkover | Hazel Park | 14 | Steel Girder & Floor Beam | Concrete Continuous Slab | 0 | 8.86' | 14'-8" L 14'-10" R | Pedestrian | 1966 |
| | | | 469 | | | 8 | 79.7' L 79.7' R | | | |
| S28 of 63174 | Woodward Heights Blvd. | Hazel Park | 2 | Steel Stringer Composite | | 5 | 66.27' | 15'-5" L 15'-10" R | H20 | 1966 |
| | | | 173 | | | 8 | 79.4' L 79.4' R | | | |
| P05 of 63174 | Browning Avenue Walkover | Hazel Park | 14 | Steel Girder & Floor Beam | Concrete Continuous Slab | 0 | 8.86' | 15'-2" L 14'-5" R | Pedestrian | 1969 |
| | | | 489 | | | 8 | 73.2' L 73.2' R | | | |
| S04 of 63103 | Shevlin Road Double U Turn | Hazel Park | 2 | Steel Stringer Plate Girder Composite | | 3 | 58.73' | 16'-0" L 15'-5" R | HS20 | 1971 |
| | | | 215 | | | 10 | 91.2' L 99.7' R | | | |
| S05 of 63103 | I-696 & 4 Ramps | Royal Oak | 5 | Steel Stringer Continuous Composite | | 8 | 152.56' | 17'-0" L 15'-0" R | HS20+Mod | 1971 |
| | | | 670 | | | 2 | 42' L 42' R | | | |
| S16 of 63103 | Ramp NB I-75 to WB I-696 | @ I-75 | 4 | Steel Stringer Plate Girder Composite | | 2 | 44.29' | 16'-9" R | HS20+Mod | 1971 |
| | | | 408 | | | 2 | 26.9' L 26.9' R | | | |
| S17 of 63103 | Ramp SB I-75 to EB I-696 | @ I-75 | 4 | Steel Stringer Plate Girder Composite | | 2 | 44.29' | 16'-5" R | HS20+Mod | 1971 |
| | | | 408 | | | 2 | 26.9' L 26.9' R | | | |
| S18 of 63103 | Ramp EB I-696 to NB I-75 | @ I-75 | 4 | Steel Stringer Plate Girder Composite | | 1 | 29.2' | 16'-3" R | HS20+Mod | 1971 |
| | | | 322 | | | 6 | 67.3' L 67.3' R | | | |
| S19 of 63103 | Ramp WB I-696 to SB I-75 | @ I-75 | 4 | Steel Stringer Plate Girder Composite | | 1 | 29.2' | 14'-11" R | HS20+Mod | 1971 |
| | | | 316 | | | 6 | 67.3' L 67.3' R | | | |
| S06 of 63103 | Dallas Avenue Double U Turn | Royal Oak | 2 | Steel Stringer Continuous Composite | | 3 | 58.73' | 16'-0" L 15'-0" R | HS20 | 1971 |
| | | | 221 | | | 10 | 99.7' L 95.8' R | | | |
| S30 of 63174 | 10 1/2 Mile Road | Royal Oak | 2 | Steel Stringer Composite | | 4 | 66.27' | 16'-9" R | H20 | 1971 |
| | | | 172 | | | 8 | 79.7' L 79.7' R | | | |
| S31 of 63174 | 11 Mile Road | Royal Oak | 4 | Steel Stringer Composite | | 6 | 85.3' | 16'-0" L 15'-0" R | H20 | 1966 |
| | | | 197 | | | 6 | 60' L 60' R | | | |
| S01 of 63174 | Gardenia Avenue | Royal Oak | 2 | Steel Stringer Continuous | | 4 | 58.4' | 16'-0" L 15'-0" R | HS20 | 1963 |
| | | | 130 | | | 6 | 59.4' L 59.4' R | | | 1996 |
| S02 of 63174 | NB Service Drive | Royal Oak | 2 | Steel Stringer Continuous | | 2 | 33.79' | 16'-0" R | H20 | 1963 |
| | | | 220 | | | 6 | 65.9' L 65.9' R | | | |

**Table 2-5 Pedestrian Facility Characteristics**

| BRIDGE/UNDERPASS LOCATION | SIDEWALKS | SHOULDERS | HANDICAP ACCESS |
|---|---|---|---|
| Bernhard Street Walkover | N/A | N/A | Yes |
| Meyers Avenue | N & S | No | Yes |
| Harry Avenue Walkover | N/A | N/A | Yes |
| Highland Avenue Walkover | N/A | N/A | Yes |
| Southbound U Turn at John R Road | No | No | No |
| John R Road | E & W | No | Yes |
| Northbound U Turn at John R Road | No | No | No |
| Southbound U Turn at 9 Mile Road | No | No | No |
| 9 Mile Road | N & S | No | Yes |
| Orchard Street Walkover | N/A | N/A | Yes |
| Woodward Heights Blvd. | N & S | No | Yes |
| Browning Avenue Walkover | N/A | N/A | Yes |
| Shevlin Road Double U Turn | No | No | No |
| Sidewalks along Service Drives through I-696 Interchange | West side only | No | West side only |
| Dallas Avenue Double U Turn (Removed)<br>(Now at Lincoln Avenue) | No | No | No |
| 10 ½ Mile Road (Lincoln Avenue) | N & S | No | No |
| 11 Mile Road | N & S | No | No |
| Gardenia Avenue | N & S | No | No |
| NB Service Drive | N | No | No |
| | | | |

N = north; S = south; E = east; W = west; SB = southbound; NB = northbound; N/A = not applicable; ADA = Americans with Disabilities Act

# 3.0 Design Criteria

The following section presents the design criteria used for roadway, bridges, and drainage.

## *3.1 Roadway*

Roadway design criteria were developed using a combination of the following sources as reference:

- Michigan Road Design Manual
- Michigan Geometric Design Guides
- AASHTO Policy on Design Standards Interstate System
- AASHTO Policy on Geometric Design of Highways and Streets
- MDOT Standard Plans
- MDOT Special Details

A comprehensive list of updated design criteria for freeway, ramps, and service drives is provided in Table 3-1.

The primary design criteria includes a design speed of 75 miles per hour (mph) and a posted 70-mph speed limit. The lanes are 12 feet wide with a minimum median shoulder width of 10 feet and an outside shoulder width of 12 feet. The ramps are designed using a design speed of 25 to 45 mph.

## *3.2 Bridges*

The bridge design criteria was developed using the following sources as a reference:

- Michigan Road Design Manual
- Michigan Bridge Design Manual
- Michigan Bridge Design Guides
- Michigan Geometric Design Guides
- AASHTO Policy on Design Standards in System
- MDOT Standard Plans
- MDOT Special Details

The vertical clearance elements include a 14-foot, 9-inch (14’9”) underclearance south of I-696 and a 16’3” underclearance north of I-696. Table 3-2 provides the bridge design criteria.

## *3.3 Drainage*

The drainage design criteria are primarily based on the MDOT Drainage Manual. The criteria covered addresses hydrologic methodology and storm sewers. Table 3-3 provides the drainage design criteria.

**Table 3-1 Mainline, Ramp, and Service Drive Design Criteria**

| ITEM | REFERENCE | MINIMUM CRITERIA | PROPOSED CRITERIA | REMARKS |
|---|---|---|---|---|
| MAINLINE I-75 | | | | |
| Design Speed | MRDM 3.06 App. 3-A | 75 mph | 75 mph | Posted 70 mph per the *Michigan Vehicle Code*. Use 75 mph per MRDM. |
| | AASHTO (Int) | 70 mph | | |
| Lane Width | MRDM App 3-A & 6-A | 12' | 12' | |
| | AASHTO (Int) | 12' | | |
| Shoulder Width | MRDM App. 3-A & 6-A | Left: 10' Paved | Left: 10' - 8" Paved | 10-foot minimum approved in EIS and additional provided on median shoulder where available |
| | | Right: 12' Paved | Right: 12' Paved | |
| | AASHTO (Int) | 10' Paved | | |
| HORIZONTAL ALIGNMENT | | | | |
| Minimum Radius | MDOT Standard Plan R-107 | R = 2344' | R = 2344' | |
| | MRDM 3.04.03 St Line Chart | R = 2500' | | |
| Minimum Length of Curve | MRDM 3.03.01B | 15V Minimum | 15V Minimum | Value depending on radius |
| | AASHTO (Grn Bk) pg 146 | 30V Desirable | | |
| Maximum Superelevation | MDOT Standard Plan R-107 | $e_{max}$ = 0.07 '/ft | $e_{max}$ = 0.07 '/ft | |
| | MRDM 3.04.03 St Line Chart | $e_{max}$ = 0.06 '/ft | | If 7% is deemed not feasible |
| Maximum Gore Slope | MRDM 3.07.02B | 8% | 8% | |
| Maximum Rollover | MRDM 3.11.03E | 6% | | Also, per MGDG 100 and 130 series |
| | AASHTO (Grn Bk) pg 307 | 8% | | |
| Horizontal Sight Offset | AASHTO Ex 3-54, pg 226-227 | Variable | Variable | Value depending on radius |
| VERTICAL ALIGNMENT | | | | |
| Vertical Curves | AASHTO (Grn Bk) Ex 3-72 | $K_{min, crest}$ = 312 | $K_{min, crest}$ = 312 | |
| | AASHTO (Grn Bk) Ex 3-75 | $K_{min, sag}$ = 206 | $K_{min, sag}$ = 206 | |
| | AASHTO (Grn Bk) pg 276 | $L_{min, sag}$ = 225 | $L_{min, sag}$ = 225 | |
| Grade | MRDM 2.02.01& App. 3-A | Max = 3% | Max = 3% | For shoulder section |
| | AASHTO (Grn Bk) pg 506 | Max = 8% | | |
| Stopping Sight Distance | AASHTO (Grn Bk) Ex 3-72 & 3-75, pg 227 | 820' | 820' | |
| Cross Slope | MRDM, Ap. 3A - Pavement | 2% | 2% | |
| | MRDM, Ap. 3A - Shoulder | 4% | 4% | |
| | AASHTO (Int) - Pavement | 1.5% - 2.5% | | |
| | AASHTO (Int) - Shoulder | 6% | | |
| Vertical Underclearance | MRDM 3.12G & 7.01.08 & App. 3-A | 16' - 0" (North of I-696) | 16' - 0" (North of I-696) | |
| | | 14' - 6" (South of I-696) | 14' - 6" (South of I-696) | Special route |
| Horizontal Clearance | MBDG 6.05 | shoulder + 2' | shoulder + 2' | Urban trunklines—Retaining wall sections |
| Concrete Barrier Flare Rate | MGDG pg 5-32 | 20:1 minimum<br>30:1 maximum | 20:1 minimum<br>30:1 maximum | |
| RAMPS | | | | |
| Design Speed | MRDM App. 3-A | 45 mph | 45 mph | Non-slip ramps (I-696 ramps) |
| | AASHTO (Grn Bk) Ex 10-56 | 25 - 45 mph | 25 - 45 mph | Urban slip ramps |
| Lane Width | MRDM App. 3-A & 6-A | 12' | 12' | Urban slip ramps |
| | | 16' | 16' | Non-slip ramps |
| Curb Type | MRDM App. 6-A | 2'-6" left (Det D)<br>3'-4" right (Det G1) | 2'-6" left (Det D)<br>3'-4" right (Det G1) | Urban slip ramps |
| Shoulder Width | MRDM App. 3-A & 6-A | Left: 6' (4' Paved) | Left: 6' (4' Paved) | Non-slip ramps |
| | | Right: 8' (7' Paved) | Right: 8' (7' Paved) | |
| | MRDM App. 6-A | 5' | 5' | Urban slip ramps |
| Horizontal Alignment | MRDM 3.04.03 St Line Chart | $R_{min}$ = 250' | Varies | Slip ramps radius per R-107 |
| | MGDG 2.02 | Varies | Varies | Non-slip ramp per 3.11.04 & St Line Chart |
| Vertical Alignment | AASHTO (Grn Bk) Ex 3-72 | Varies | Varies | Value should meet/exceed horizontal criteria |
| | AASHTO (Grn Bk) Ex 3-75 | Varies | Varies | |
| | AASHTO (Grn Bk) pg 276 | Varies | Varies | |
| Grade | MRDM 2.02.01, App. 3-A | Max = 5% | Max = 5% | |
| | AASHTO (Grn Bk) pg 828 - 829 | Max = 8% | Max = 8% | |
| Stopping Sight Distance | AASHTO (Grn Bk) pg 227 | Varies | Varies | Value should meet/exceed horizontal criteria |
| Cross Slope | MRDM, App. 3A - Pavement | 2% | 2% | |
| | MRDM, App. 3A - Shoulder | 4% | 4% | |
| Acceleration Lanes—Slip Ramps | MGDG Plan VII-202 | Varies | Varies | Varies with ramp design speed |
| | AASHTO (Grn Bk) pg 845-849 | Varies | Varies | |
| Deceleration Lanes—Slip Ramps | MGDG Plan VII-202 | Varies | Varies | |
| | AASHTO (Grn Bk) pg 849-852 | Varies | Varies | |
| Acceleration Lanes—Non-Slip Ramps | MGDG Plan GEO 100 - 300 Series | Varies | Varies | Acceleration lane length dependent on mainline roadway grade. Deceleration lane length dependent on ramp grade. |
| Deceleration Lanes—Non-Slip Ramps | MGDG Plan GEO 100 - 300 Series | Varies | Varies | |
| SERVICE DRIVES, AUXILIARY ROADWAYS | | | | |
| Design Speed | MRDM | 40 - 45 mph | 40 - 45 mph | Posted speed 35 - 40 mph |
| Lane Width | MRDM | 12' | 12' | Per EIS |
| Curb Type | MDOT Standard Plan R-30 | Type C | Type C | |
| Cross Slope | MRDM, App. 3A - Pavement | 2% | 2% | |
| | AASHTO (Grn Bk) - Pavement | 1.5% minimum | | |
| Shoulder Transition | MGDG 100 - 300 Series | 25:1 | 25:1 | |
| Sidewalk Width | MDOT Standard Plan R-28 | 5' | 5' | |
| Sidewalks | Current ADA Standards; MDOT Standard Plan R-28 | Varies | Varies | Critical elements include: sidewalk width, cross slope, ramps (per MDOT Standard Plan R-28), landing area size, surfacing |

Reference Key:

MRDM—Michigan Road Design Manual

MBDM—-Michigan Bridge Design Manual

MBDG—Michigan Bridge Design Guides

MGDG—Michigan Geometric Design Guides

AASHTO (Int) —AASHTO Policy on Design Standards Interstate System

AASHTO (Grn Bk) —AASHTO Policy on Geometric Design of Highways and Streets

**Table 3-2 Bridge Design Criteria**

| ITEM | CRITERIA | REFERENCE |
|---|---|---|
| Substructure Concrete (Grade S2) | f'c = 3,000 psi | MBDM 7.01.03 |
| Superstructure Concrete (Grade D) | f'c = 4,000 psi | MBDM 7.01.03 |
| Steel Reinforcement (Sub & Super) | fy = 60,000 psi | MBDM 7.01.03 |
| Steel Reinforcement (Concrete Beam Stirrups) | fy = 60,000 psi | MBDM 7.01.03 |
| Prestressed Concrete | f'c = 5,000 – 7,000 psi | MBDM 7.01.03 |
| Prestressing Strands | f's = 270,000 psi | MBDM 7.01.03 |
| Live Load | HL-93 Modified | MBDM 7.01.04A |
| Future Wearing Surface | 25 lbs/sft (additional design load) | MBDM 7.01.04H |
| Stay-In-Place Forms | 15 lbs/sft (additional design load) | MBDM 7.01.04I |
| Vertical Clearance Cross Roads | 16'-3" minimum north of I-696 / 14'-9" minimum south of I-696 | MBDM 7.01.08 |
| Vertical Clearance Pedestrian Structure | 17'-3" minimum north of I-696 / 15'-9" minimum south of I-696 | MBDM 7.01.08 |
| Horizontal Clear Zone Median | 30'-0" minimum – 34'-0" desirable to toe of 1 on 2 slope or pier/full height abutment wall, unless protected with a continuous crash-tested barrier system | MBDG 6.06 Series |
| Horizontal Clear Zone Outside | 30'-0" minimum – 34'-0" desirable to toe of 1 on 2 slope or pier/full height abutment wall, unless protected with a continuous crash-tested barrier system | MBDG 6.06 Series |
| Longitudinal Deck Grade | 0.3% minimum – 0.4% or greater desired | MBDM 7.01.09 |
| Transverse Deck Grade (Cross Slope) | 1.5% minimum – 2.0% desired | MBDM 7.02.19G |
| Structure Lane Width | 12'-0" | MBDG 6.05 Series |
| Structure Shoulder Width | 2'-0" shy distance | MBDG 6.05.02 |
| Bridge Deck Expansion and Contraction | Slab continuous over substructures with expansion joints off of the structure at the end of the bridge approach slabs | MBDG 6.20.03A, 6.20.04B, 6.20.04C |
| Bridge Sidewalk Width | 5'-2" minimum | MBDG 6.29.10C |
| Pedestrian Bridge Width | 3'-0" minimum – 8'-0" desired, 2-way with 1'-0" shy | ADAAG 4.8.3 |

Reference Key:

MBDM—Michigan Bridge Design Manual

MBDG —Michigan Bridge Design Guides

ADAAG —Americans with Disabilities Act (ADA) Accessibility Guide

**Table 3-3 Drainage Design Criteria**

| ITEM | DESIGN CRITERIA | REFERENCE |
|---|---|---|
| HYDROLOGIC METHODOLOGY | | |
| SCS METHOD (FOR PUMP STATION DRAINAGE DISTRICTS): | | |
| Design Storm (depressed freeways-trunklines) | 50-year storm (24 hour) | MDOT Drainage Manual 3.3.2.2 |
| SCS Method Max Drainage Area Size | 20 square miles | Computing Flood Discharges for Small Ungaged Watersheds Michigan Department of Environmental Quality, page 2 |
| Soil Types within Project | Urban Fill (Soil Type D) | |
| Common Runoff Curve Numbers | (See Table 6.1) | Computing Flood Discharges for Small Ungaged Watersheds Michigan Department of Environmental Quality, page 14 |
| Open Spaces (Good Condition) | Soil Type C - 74 Soil Type D - 80 | |
| Open Spaces (Fair Condition) | Soil Type C - 79 Soil Type D - 84 | |
| Paved Areas | All Soil Types - 98 | |
| Commercial or Business Area (85% impervious) | Soil Type C - 94 Soil Type D - 95 | |
| Residential (1/8 acre) | Soil Type C - 90 Soil Type D - 92 | |
| Residential (1/4 acre) | Soil Type C - 83 Soil Type D - 87 | |
| Residential (1/3 acre) | Soil Type C - 81 Soil Type D - 86 | |
| Residential (1/2 acre) | Soil Type C - 80 Soil Type D - 85 | |
| Residential (1 acre) | Soil Type C - 79 Soil Type D - 84 | |
| Time of Concentration (hours) | $T_c = \frac{L}{V * 3600 \frac{sec}{hour}}, where V = K * S^{0.5}$ | Computing Flood Discharges for Small Ungaged Watersheds Michigan Department of Environmental Quality. page 18; V(ft/s)= Velocity of Flow; L(ft)= Length of Flow Path; S(%)=Slope of Flow Path; Small Tributary K=2.1; Waterway K=1.2; Sheet Flow (300 feet max) K=0.48 |
| RATIONAL METHOD (FOR SERVICE DRIVES AND LOCAL ROADS): | | |
| Design Storm (general storm sewer-service drive/local roads) | 10-year storm | MDOT Drainage Manual 3.3.2.2 |
| Rational Method Max Drainage Area Size | 20 acres | MDOT Drainage Manual 3.3.7 |
| Range of Runoff Coefficients for Various Land Types | | MDOT Drainage Manual 3.4.1.4 |
| Initial Time of Concentration | 10 minutes (for depressed freeways), 15 minutes (other) | MDOT Drainage Manual 7.3.7 |
| STORM SEWERS | | |
| Minimum Gutter Grades | 0.3% for curbed pavements with a 0.2% minimum | |
| Freeboard (RIM - HGL) | In surcharged areas, 1-foot below gutter | |
| Type and Width of Curb and Gutter (left and right) | | |
| Service Drive Right and Left | Concrete Curb and Concrete Curb and Gutter Type F5 | MDOT Standard Plans |
| Urban Freeway RT Shoulder | Concrete Curb and Concrete Curb and Gutter Type G2 | MDOT Standard Plans |
| Urban Freeway LT Shoulder | Concrete Valley Gutter and Urban Freeway Curb | MDOT Standard Plans |
| Urban Slip Ramp RT (Service Interchanges) | Concrete Curb and Concrete Curb and Gutter Type G1 | MDOT Standard Plans |
| Urban Slip Ramp LT (Service Interchanges) | Concrete Curb and Concrete Curb and Gutter Type D1 | MDOT Standard Plans |
| Type of Drainage Structure Covers | | |
| Drainage Structure Covers for Manholes | Cover B | MDOT Standard Plans |
| Drainage Covers for Use with Concrete Valley Gutter | Cover VG | MDOT Standard Plans |
| Drainage Covers for Use with Concrete Curb and Gutter, Detail D and Freeways | Cover CX | MDOT Standard Plans |
| Drainage Covers for Use with Concrete C&G details Type F3, F4, F5, F6 | Cover K | MDOT Standard Plans |
| Allowable Gutter Flow Spread | Contained within shoulder for the 50-year (2% chance) event for the depressed freeway section<br>For high volume roadways – 10-year design frequency<br>For sag points – 50-year Design Frequency | FHWA HEC-23 4.1.1 |
| Supplemental Inlets | To be provided at the sag locations for clogging | MDOT Drainage Manual 7.4.6.7 |
| Maximum Inlet Spacing | 300 feet | |
| Manning's n for gutters and pavement | | See Table 7-1 MDOT Drainage Manual |
| Concrete Gutter; Troweled Finish | n = 0.012 | |
| Asphalt Pavement | n = 0.013(smooth) n = 0.016(rough) | |
| Concrete Gutter-Asphalt Pavement | n = 0.013(smooth) n = 0.015(rough) | |
| Concrete Pavement | n = 0.014(float finish) n = 0.016(broom finish) | |
| Manhole Types | | |
| Sewers 48" and Under | Standard Plan R-1 Series | MDOT Standard Plans |
| Intermediate Manhole between Junctures on Sewers (48" diameter to 108" diameter) | Standard Plan R-2 Series | MDOT Standard Plans |
| Precast Manhole Tee's for Sewers 42-in to 144-in | Standard Plan R-3 Series | MDOT Standard Plans |
| Sewer Junctions of Sewers 48-in through 108-in | Standard Plan R-4 Series | MDOT Standard Plans |
| Manhole Maximum Pipe Size | | See Table 7-4 MDOT Drainage Manual |
| Minimum Pipe Size | 12 inches | |
| Minimum Pipe Velocity (flowing full) | 3 fps | |
| Maximum Pipe Velocity | 12 fps (6 fps or greater, energy dissipation will be used) | |
| Manning's n for Concrete Pipe | n = 0.013 | |
| Manning's n for Steel (CSP or CMP) Pipe | n = 0.024 | |
| Minimum Pipe Slope (self-cleaning) | | See Table 7-6 MDOT Drainage Manual |
| Minimum Pipe Cover | Min 3 feet where possible. | |
| Drainage Structure Diameter | Min = 24 inches Max = 120 inches | |
| Minimum Distance between Pipes in Structures | Outside diameters within 1 foot of each other | |
| Maximum Manhole Spacing | 36" sewer diameter and under - 300'. 42" sewer diameter and over - 100 pipe diameters apart | |

Reference Key:

FHWA HEC-23 4.1.1—Federal Highway Administration, Hydraulic Engineering Circular, No. 22, Third Edition, Urban Drainage Design Manual 4.1.1

# 4.0 Constructability Review

This section describes the analysis for "constructability" of the reconstruction of the freeway. The evaluation addresses the key components for the design and delivery of the project and includes bridge and road reconstruction, drainage facilities, utility reconstruction, construction of an HOV lane in each direction, construction staging, and maintenance of traffic.

The corridor between M-102 and 12 Mile Road will be completely reconstructed. The work will include ramp and service drive reconstruction with the exception of the I-696 interchange. Only portions of the eastbound I-696 ramp to northbound (NB) I-75 and the westbound I-696 ramp to NB I-75 will be impacted. These ramps will be reconstructed due to existing congestion with the 11 Mile Road off-ramp from NB I-75. The northbound I-75 entrance ramps from eastbound and westbound I-696 will be combined and braided over the northbound I-75 exit ramp to 11 Mile Road, south of Lincoln Avenue (See Figure 4-1 and Section 5.6, I-696 Interchange, discusses the ramp braid concept). The existing service drive in this vicinity will also be realigned and reconstructed to accommodate the ramp. Right-of-way (ROW) acquisition will be required for this improvement.

Existing bridges within this corridor will be removed and replaced, with the exception of the Dallas Avenue bridge that will be removed. It will not be replaced because of its close proximity to the ramp braiding improvement at this location. The traffic movements from the Dallas Avenue bridge can be accommodated at the Lincoln Avenue bridge. The 9 Mile Road bridge was reconstructed in summer 2009 and has been designed to conform to the proposed future I-75 alignment and reconstruction. The bridge will not be rebuilt, however its center pier will be relocated. Portions of its future center pier foundation have been installed to ease future constructability. Since the freeway will be widened to accommodate an additional lane in each direction, new retaining walls will be constructed in cut sections to allow the work to be completed within the existing ROW as much as possible. Existing sound walls will be rebuilt with the service drive reconstruction.

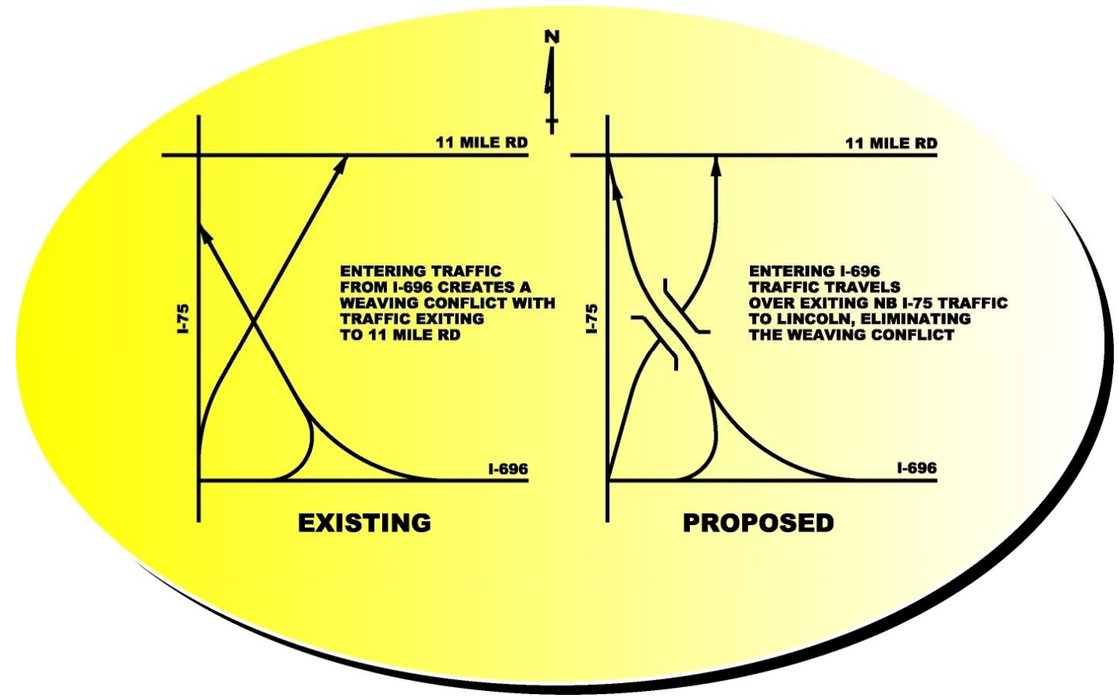
The storm water outlet for the freeway drainage is currently pumped into a combined sewer that generally runs north along the west side service drive. This existing combined sewer system will remain in place, but drainage from the reconstructed freeway will be removed and redirected to a new storm sewer running along the east side service drive. The existing pump stations lift water to the west side and will be removed and replaced along the new east side storm sewer. The new separated trunk storm sewer will be constructed at an elevation approximately 30 feet below the proposed service drive. Only surface water from the reconstructed freeway, bridges, and ramps will outlet into the new trunk sewer. Seven new pump stations and one in-line pump station will be constructed along the NB service drive to facilitate corridor drainage and outlet into the Red Run Drain at Dequindre Road.

## *4.1 Bridge and Road Reconstruction Constructability*

I-75 should be closed for short durations in both directions for demolition of the existing bridges and for the setting of the new bridge beams. Existing service drives should be used for detours where possible. U-turn bridges should be constructed separate from cross road bridges over I-75 to ensure enough room to allow commercial vehicle access and width to prevent damage to the superstructure. Design-build is a fast track delivery concept that could be utilized instead of the traditional design-bid-build procurement. Below are other delivery concepts for expediting project completion:

- Use advanced procurement methods for specialized material purchases
- Use communications software for design/construction process
- Expedite shop drawings and plan review procedures
- Use a conflict resolution team to address construction conflicts and delays

**Figure 4-1 Existing and Proposed NB I-75 and I-696 Braid**




It is understood that MDOT will perform a life-cycle analysis to determine the appropriate pavement structure; however, it is suggested that due to extensive traffic staging and shifting, a full depth hot mix asphalt (HMA) pavement should be considered. A perpetual pavement concept that uses gap graded superpave mixtures should be used in lieu of concrete to ensure long-term pavement performance with reduced life cycle costs. These high performance HMA mixtures enhance pavement durability during and after construction through the use of cellulose fibers and polymer modified asphalt binder. The use of HMA pavement results in the following benefits over concrete:

- Allows traffic staging changes sooner with less cure time than concrete pavement (less weather sensitive)
- Accommodates variable pavement widths during construction due to the lack of longitudinal joints
- Lower initial cost; however, future maintenance costs of asphalt need to be considered
- Does not require the finished top course surface to maintain traffic, allowing for higher degree of traffic staging flexibility
- Eliminates the scarring of pavement from temporary pavement marking removals
- Allows paving top course after all stage construction is completed when traffic is in its final configuration. This hides traffic staging scars and provides a clean look upon completion

- Due to its flexibility, HMA provides a higher level of service for traffic during all stages of construction
- Results in lower noise from traffic
- Provides a higher level of ride quality for traffic, with respect to smoothness

## 4.2 Construction Phasing

There are certain construction components that optimize concurrent construction techniques and coordinated traffic management practices. The following are construction stages of component construction:

1. NB service drive reconstruction with trunkline storm sewer, pump stations, and retaining wall construction
2. NB I-75 road, ramp, and bridge reconstruction from I-696 to approximately 13½ Mile Road (to be coordinated with the northern section)
3. Southbound (SB) I-75 road, ramp, and service drive reconstruction from 13½ Mile Road (to be coordinated with the northern section) to approximately I-696
4. Braided ramp and bridge reconstruction from I-696 to Lincoln
5. NB I-75 road, ramp, and bridge reconstruction from M-102 to I-696
6. SB I-75 road, ramp, and service drive reconstruction from I-696 to M-102

## 4.3 Maintenance of Traffic (MOT)

Traffic can be maintained with two or three lanes in each direction, as opposed to full closure. See *Maintenance of Traffic Technical Memorandum, I-75, M-102 to South of 12 Mile Road,* December 2009 for more detail. Advisory signing for alternate routes should be installed region-wide. When full or partial freeway closures are needed to allow unencumbered road or bridge construction, any cross roads over I-75, except 9 Mile Road and 11 Mile Road, should be closed as required to complete the work.

The existing and proposed NB and SB service drives are wide enough to handle maintaining freeway traffic during certain stages of construction. Temporary HMA resurfacing would be needed at several locations prior to construction. All intersecting side streets adjacent to service drives should be closed using temporary concrete barriers. A temporary fence should be installed the full length of construction along the service drives to separate pedestrian traffic. At locations along the service drive where driveway access needs to be maintained, temporary pavement markings, signs, and supplemental traffic control devices need to be provided to separate local traffic.

## 4.4 Drainage Constructability

The current storm water drainage system is a large diameter pipe under the southbound service drive. This pipe combines local storm water and freeway runoff, pumped from the freeway floor via a series of seven (7) pump stations. This combined water then runs north to the Twelve Towns Drain, located northeast of the I-696 and I-75 interchange. The Twelve Towns Drain is a combined sewer system that flows to the Twelve Towns Retention Treatment Facility (RTF) located northeast of I-75 and 12 Mile Road. During off-peak hours, the storm water flow is accumulated and treated by the Detroit Wastewater Treatment Plant via the Dequindre Interceptor. During peak hours, the Twelve Towns Drain overflows to the Red Run Drain. The proposed storm sewer system involves installing a new storm sewer trunkline and seven (7) new pump stations. The proposed storm sewer trunkline will be located under the NB I-75 service drive.

The purpose of replacing the existing storm sewer system is to separate the I-75 stormwater from the Twelve Towns Drain sewer system and to increase the system capacity in the current I-75 drainage system. This will reduce the flows to the Twelve Towns RTF and improve the quality of discharge to the Red Run Drain while improving the drainage for I-75.Below are several constructability issues and innovations involved with the proposed drainage system:

- Maintaining drainage on I-75 during road/bridge reconstruction: This option can be accomplished using a part-width method of construction. Following completion of the pre-stage work associated with the construction of the proposed storm sewer system, construction of the proposed trunkline along the NB service drive will begin. While being constructed, drainage will remain operational in the existing trunkline along the SB service drive. Subsequently, during the reconstruction of SB freeway and service drive, the drainage will be directed to the newly installed storm sewer system to the east. To allow each half of the drainage systems to operate independently between work stages, temporary bulkheads will be installed in the new storm sewer pipe at the centerline.
- Installing the new storm sewer trunkline by one and/or two methods (open cut construction and/or tunnel boring): Within the limits of reconstruction, it may be necessary to use either method, depending on existing conditions. Tunnel boring the entire length requires a 12 foot minimum diameter sewer pipe. However, using the method of open cut construction, the diameter of the sewer pipe would increase incrementally per hydraulic flow specifications. Breaking the total length into segments, with different installation methods would reduce overall cost, properly stage the construction to coincide with the road and bridge reconstruction, and reduce the total time for project completion. Refer to Section 5.10 for discussion of the tunnel option for storm sewer construction.
- Potential damaging vibrations occurring during pavement removal and storm sewer installation to adjacent buildings and/or structures on the NB I-75 service drive: This could be avoided by performing continuous monitoring of the worksite to limit vibrations from reaching peak particle velocities by placing ground vibration monitoring devices around each probable area. The contractor should be required to submit a plan prior to construction for monitoring vibrations and any potential damage to adjacent buildings. A survey of the drainage influence area should also be required to measure settlement.
- Hazardous worksite around open cut construction: Protecting the worksite on a daily basis and signing off on the daily safety precautionary measures are ways that worksite injuries can be prevented. The safety plan submitted by the contractor should include a point of contact and plan of action with daily safety precautionary measures detailed.
- Post construction settlement of concrete sewer placed by method of open cut: Due to the weight of concrete sewer pipe and the possibilities of having existing clayey type soil, it would be valuable to perform depth check measurements, as installation of the concrete sewer pipe progresses. This would ensure that the intended slope of the concrete sewer pipe is being achieved.

## 4.5 Utility Constructability

Due to the extensive reconstruction, it is anticipated that there will be a substantial number of public and private utility impacts, requiring a major coordination effort for the relocation or modification of these facilities. This will involve unique construction methods and coordinated teamwork to prevent disruptions in service and avoid construction delays. Below are some techniques used on other construction projects involving critical utility elements.

Methods for temporarily supporting utilities that require continuous service should be considered:

- Installing a temporary support from the ground below midspan between two points. There are requirements for each utility in how long a utility can span without support. The requirement should be investigated prior to design.
- Suspending an overhead service from an H-beam supported by each fixed side

Communication is important for successful utility coordination and should include:

- Continuous utility coordination amongst each maintaining agency prior to, and during, each stage of construction, including splicing cables, electrical manhole reconstruction, cable removal, and installation, and others
- Contacting MISSDIG prior to performing any utility excavations
- Establishing understandable reporting and communicating processes
- Notifying residents and business owners in advance when utility disruptions are planned. Requirements should be the responsibility of the contractor

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# 5.0 Preliminary Design Analysis

This section updates design elements as part of this Engineering Report.

## *5.1 Design Traffic Volumes*

The traffic analysis for the Final Environmental Impact Statement (FEIS) used the Southeast Michigan Council of Governments (SEMCOG) model, with modifications for an afternoon peak hour, along with transit and high-occupancy vehicle (HOV) analyses, to forecast traffic conditions with and without the Preferred Alternative (Build Alternative) for the year 2025. The No-Build Alternative assumes that the projected population and employment growth will occur, and the committed/cost-feasible road improvements will be built, but that no capacity improvements will be made within the project area other than normal maintenance. The year 2025 was selected because projects constructed with federal funds must address traffic needs for at least 20 years into the future. The projections, as shown in Table 5-1, indicate that in 2025 without improvements I-75 will experience severe congestion throughout the project corridor.

In the AM peak hour, level-of-service (LOS) will decrease in two segments, and one segment will remain at LOS F compared to the existing conditions shown in Section 2, Table 2-1. In the PM peak hour, LOS will decrease in all four segments, with two segments showing LOS F conditions compared to the existing conditions shown in Section 2, Table 2-1.

With the proposed project, one lane would be added in each direction to bring I-75 to four through lanes between M-102 (8 Mile Road) and 12 Mile Road. In the AM and PM peak hours, there would be no segments experiencing LOS F in either direction (Table 5-1). In both peak periods, three segments would be at LOS D (or better) and one would be at LOS E. These are acceptable conditions under limited circumstances in constrained urban situations during peak hours of the day.

**Table 5-1 2025 Peak Hour Traffic Volumes and LOS for I-75 – No Build and Build Alternatives**

| SEGMENT | AM PEAK | | | | PM PEAK | | | |
|---|---|---|---|---|---|---|---|---|
| | NO-BUILD | | BUILD | | NO-BUILD | | BUILD | |
| | NB Volume/ LOS | SB Volume/ LOS | NB Volume/ LOS | SB Volume/ LOS | NB Volume/ LOS | SB Volume/ LOS | NB Volume/ LOS | SB Volume/ LOS |
| 8 Mile Road to 9 Mile Road | 5,000/C | 6,790/D | 6,030/C | 7,185/D | 7,190/E | 7,450/E | 7,280/D | 7,900/D |
| 9 Mile Road to I-696 | 5,640/D | 7,130/E | 6,740/C | 7,525/D | 7,560/E | 8,140/E | 7,690/D | 8,640/D |
| I-696 to 11 Mile Road | 5,670/D | 7,530/E | 6,740/C | 7,925/D | 7,640/E | 8,410/F | 7,850/D | 9,015/D |
| 11 Mile Road to 12 Mile Road | 6,140/F | 6,250/F | 7,340/E | 6,645/D | 7,240/F | 7,380/F | 7,540/E | 8,045/E |

Source: Final Environmental Impact Statement, I-75 from M-102 to M-59, Oakland County, Michigan, April 2005
NB = northbound; SB = southbound; LOS = level of service

## *5.2 Safety*

The original crash analysis evaluated data from January 1995 to the end of 2001. Since this time, several years of crash data have been collected by SEMCOG. Using data provided by SEMCOG's crash database, the crash analysis was updated for 2002 through 2008. The Average Annual Daily Traffic was obtained from the Michigan Department of Transportation (MDOT).

From January 2002 to the end of 2008, 4,323 crashes were reported on I-75 between M-102 and south of 12 Mile Road. The most common crash type was rear-end (55%), followed by single vehicle crashes (21%) and sideswipe (15%) (see Table 5-2). There were 1,506 injuries and eight fatalities. Four of the fatal crashes involved alcohol. Of the remaining fatal crashes; two were rear-end, one was a side swipe crash, and one was listed as an unknown crash.

**Table 5-2 I-75 Northbound and Southbound Crashes by Segment 2002-2008**

| NB AND SB I-75 SEGMENTS | TOTAL CRASHES | INJURIES | FATALITIES | CRASH TYPE | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SINGLE VEHICLE | HEAD-ON | ANGLE | REAR-END | SIDE SWIPE SAME | SIDE SWIPE OPPOSITE | OTHER & UNKNOWN |
| 8 Mile Road to South of 9 Mile Road | 1,327 | 478 | 5 | 476 | 8 | 74 | 449 | 207 | 6 | 107 |
| South of 9 Mile Road to South of I-696 | 1,046 | 367 | 2 | 163 | 6 | 45 | 647 | 138 | 5 | 42 |
| South of I-696 to North of I-696 | 714 | 224 | 1 | 96 | 2 | 9 | 467 | 112 | 4 | 24 |
| North of I-696 to South of 12 Mile Road | 1,236 | 437 | 0 | 152 | 5 | 32 | 830 | 175 | 2 | 40 |

Source: Final Environmental Impact Statement, I-75 from M-102 to M-59, Oakland County, Michigan, April 2005

The average crash rate for the corridor from 2002 to 2008 was 1.32 crashes per million vehicles. In 2001, the crash rate was calculated to be 1.31 crashes per million vehicles. Table 5-3 compares crash rates from 2001 with 2008. In comparison to the Average Annual Daily Traffic (AADT) data provided as shown below, the AADT decreased. The shaded cells in Table 5-3 indicate segments that are above the average crash rate.

**Table 5-3 Crash Data by Segment Comparing 1995-2001 with 2002-2008**

| SEGMENT OF I-75 | 2001 AADT* | 2001 CRASHES | | 2008 AADT* | 2008 CRASHES | |
|---|---|---|---|---|---|---|
| | | NB** | SB** | | NB** | SB** |
| 8 Mile Road to South of 9 Mile Road | 173,000 | 0.93 | 1.22 | 161,000 | 2.00 | 1.77 |
| South of 9 Mile Road to South of I-696 | 182,000 | 2.51 | 1.45 | 169,000 | 1.88 | 0.95 |
| South of I-696 to North of I-696 | 185,000 | 2.44 | 1.41 | 176,000 | 1.26 | 0.59 |
| North of I-696 to South of 12 Mile Road | 187,000 | 2.02 | 1.25 | 171,000 | 1.32 | 1.98 |

*Average Annual Daily Traffic
**Crashes per million vehicle miles northbound or southbound

## 5.3 HOV Implementation and Enforcement Overview

The proposed part-time HOV lane will be located adjacent to the median and occupy the leftmost travel lane. When not operational as an HOV lane, this will be a general purpose lane. The designated pavement markings and signing will conform to part-time HOV lane operations as prescribed in the Manual on Uniform Traffic Control Devices (MUTCD).

**Operation**

Part-time operations are anticipated to be in both directions during the morning and evening peak periods since there is not one peak commute direction. The operational restriction may change over time, but it will at least initially include a restriction for a minimum two-hour period in the AM and PM peak commute periods (i.e., 7-9 AM and 4-6 PM). The basis for the restriction is exhibited periods of recurring congestion (speeds below 35 mph) for 85 percent of the observed commute periods. However, different thresholds associated with defined congestion once the project is ready to be opened may be considered. A change in operating hours will affect corridor signing and will need to be communicated to the public prior to the changes taking effect.

Eligible HOV users are typically as follows:

- Vehicles carrying two or more persons, including the driver
- Motorcycles
- Emergency vehicles en route to an incident
- Designated public conveyance buses, regardless of occupancy

Designated and registered hybrid vehicles may also be eligible for HOV consideration.

The HOV lane restrictions should be initially implemented with a minimum project length sufficient to generate travel time savings of several minutes. A recommendation for this project would be to open the entire improvement segment (M-102 to south of 12 Mile Road) as the first HOV segment. No portion involving the leftmost lane should be opened to general purpose traffic without:

- Either the restriction being in effect at the time of opening; or
- Temporary placards located on HOV signage being posted over the leftmost lane at frequent intervals, as shown in Figure 5-1, until such time that the entire segment can be opened.

Some states have closed off the leftmost lane with construction barricades or barrels until the affected segment can be opened all at once.

**Design**

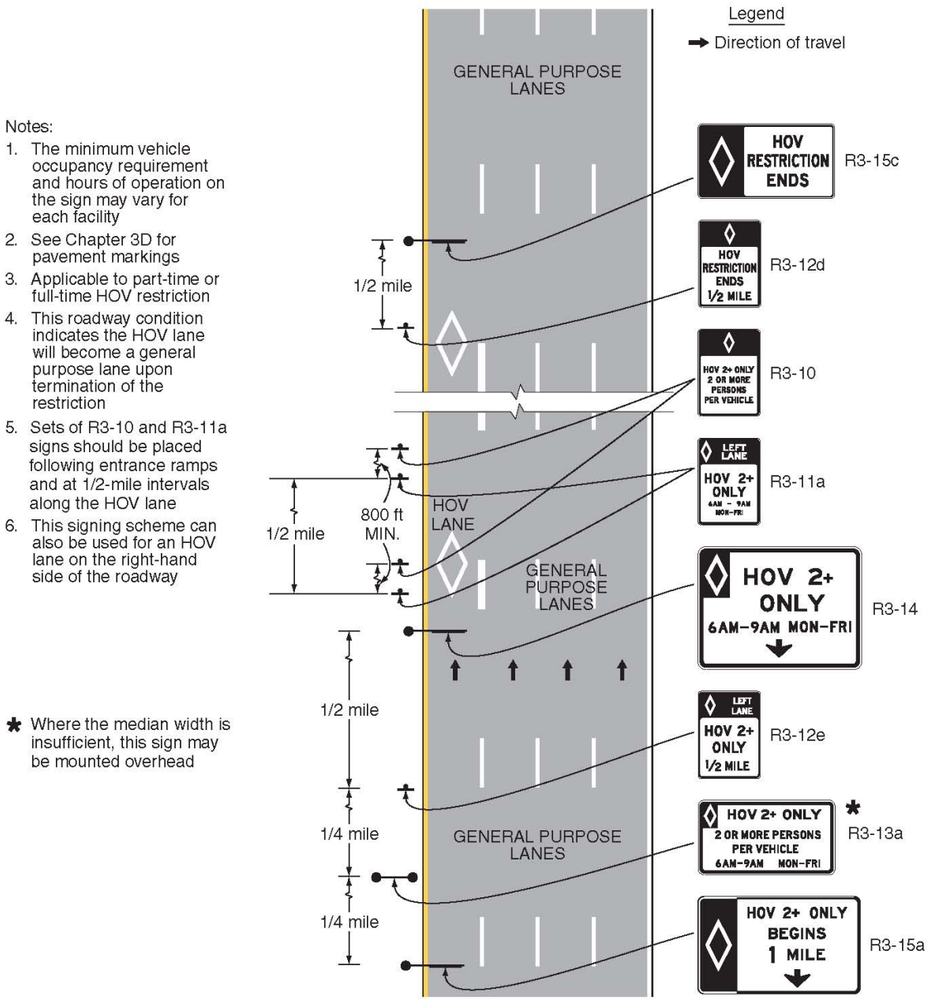
The general signing and pavement configuration for HOV operation is illustrated in Figure 5-2.

The leftmost lane will be 12 feet wide with an inside emergency breakdown/enforcement shoulder that varies from 9 to 10.8 feet along the project corridor. There will be no designated buffer between the HOV lane and adjacent lanes.

Typical signing will conform to the latest Federal Highway Administration (FHWA) rulemaking (MUTCD 2010, as amended). Both overhead and median barrier mounted signs will indicate where the HOV lane restriction begins. Solo motorists must be given adequate warning that the restriction ahead will require them to merge out of the inside lane. A cantilever sign over the affected lane will be mounted from the median barrier at the beginning of the HOV lane. The restriction will be posted one mile in advance, one-half mile in advance, at the location where the restriction takes effect, and at the end of the HOV lane restriction.

**Figure 5-1 HOV Signing Example**

**Figure 5-2 Example of Signing for a General Purpose Lane that becomes a Continuous-Access Contiguous or Buffer-Separated HOV Lane**




Source: 2009 MUTCD final rulemaking version, Federal Highway Administration.
Refer to http://edocket.access.gpo.gov/2009/pdf/E9-28322.pdf

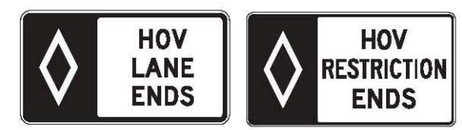
Cantilever sign for announcing where the HOV lane will begin:

R3-15a

Cantilever signs (half-mile notice; hours of operation; definition of HOV lane):

R3-12e R3-11 R3-10

At the end of the HOV lane restriction, one of the two cantilever signs shown below will be mounted over the lane:




R3-15b R3-15c

**Termini**

Due to geometric restrictions and the operational premise that the HOV lane must also function as a general purpose lane, it will begin and end as a transition to and from the designated restriction, as shown in the layout above. This notice will take the form of advance signs beginning one mile upstream of the designated termini.

**Northbound Termini**

Evaluation of the northbound direction indicates that the HOV lane can begin just north of M-102 where the freeway is widened. Adequate horizontal and vertical sight distance exists, and queues occurring from the I-696 interchange ramps can be bypassed by HOVs by starting the lane at the southern project limits (just north of M-102). The precise location for beginning the restriction needs to allow for good sight distance to the cantilevered sign, or approximately 300 to 500 feet north of the M-102 interchange. Adequate advance signs need to be posted upstream of this location. The HOV lane will continue into the adjacent project section north of 13 Mile Road to just south of M-59.

**Southbound Termini**

The southbound HOV lane will be connected to the project north of 13 Mile Road and extend southward to the I-696 interchange. The high volume of traffic entering and exiting at the I-696 interchange indicates that many HOVs will leave the southbound HOV lane prior to this location. The remaining volume traveling farther south on I-75 will be much lower than in adjacent lanes. The HOV lane was designed to M-102, although it may terminate farther north.

Different options for the proposed termination of the southbound I-75 HOV lane near M-102 were assessed in order to minimize future impacts to freeway operations. In total, six different options were analyzed. Lane-drop options on both the inside and outside lanes near M-102 were considered with different HOV lane termination points. A system-level continuity option was also considered. The HOV termination options for southbound I-75 are shown in Figure 5-3 and described in Table 5-4. The termination point for each HOV lane is depicted on the figure. In Options 1 through 4 the location where the lane drop is needed to transition from four to three lanes is also shown. The dedicated HOV lane is modeled on the inside lane in all options.

**Table 5-4 SB HOV Termination Alternative Descriptions**

| OPTION | HOV LANE TERMINATION | LANE DROP / ADDITION* |
|---|---|---|
| 1 | HOV Lane would end on tangent section just after 9 Mile curves near the proposed M-102 exit ramp | Lane drop would shift the outside general purpose traffic from Lane 4 to Lane 3 resulting in 3 lanes under M-102 |
| 2 | Same HOV as Option 1 | Lane drop would shift the inside HOV traffic from Lane 1 to Lane 2 resulting in 3 lanes under M-102 |
| 3 | HOV Lane terminates on tangent section prior to 9 Mile exit ramp | Same as Option 1 |
| 4 | Same as Option 3 | Same as Option 2 |
| 5 | Same as Options 1 and 2 | System Continuity: HOV lane plus four (three general purpose and one auxiliary) lanes through 9 Mile curves dropping one lane at the M-102 exit ramp. Would need to include improvements south of M-102 (not part of the FEIS) as four lanes continue under M-102 to the southbound M-102 entrance ramp. |
| 6 | HOV lane terminates in tangent section south of I-696 | Fifth lane or outside auxiliary lane between I-696 entrance ramp and 9 Mile Road exit ramp would drop or be exclusive exit to 9 Mile Road. Would carry only four lanes through the 9 Mile curves and the fourth lane would drop at M-102, as it exists today. Three lanes would continue underneath M-102. |

*Lanes are numbered with inside (left side) lane next to the median barrier as Lane 1; Lane 2 is to Lane 1's right; Lane 3 is to the right of Lane 2; and Lane 4 is the outside or rightmost lane.

The microsimulation traffic study area included the southbound I-75 freeway lanes from I-696 to the entrance ramp from M-102, which is south of the study limits. This section of freeway includes five ramps: I-696 eastbound entrance ramp; 9 Mile Road exit ramp; John R Road entrance ramp; M-102 exit ramp; and, M-102 entrance ramp.

VISSIM, a microscopic multimodal traffic simulation software, was used to analyze future build conditions in the AM and PM peak hours. VISSIM has been applied to many HOV projects as it is well suited to handle this type of freeway operational analysis. Based on previous transportation demand modeling efforts that were part of the FEIS, the future build year HOV volumes were assumed to be 22-percent of future overall volumes. Trucks in the peak hour were assumed to be 5-percent of the overall traffic, and the remainder of traffic was characterized as general purpose vehicles. Once the HOV lane designation ends, vehicles are allowed to use that lane**.**

Using the VISSIM model, a future year (2025) analysis was performed for each option that collected peak hour volumes, network speeds, average delay per vehicle, and total network travel time. Table 5-5 compares the total travel time along southbound I-75 between each of the six options. Options 3 through 6 demonstrate similar travel times for HOV termination.

**Table 5-5 Six HOV Termination Options for Southbound I-75 in the Peak Hours of the Day**

| NETWORK PERFORMANCE | OPTION 1 | | OPTION 2 | | OPTION 3 | | OPTION 4 | | OPTION 5 | | OPTION 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AM | PM | AM | PM | AM | PM | AM | PM | AM | PM | AM | PM |
| Total travel time [hours] Car | 359.9 | 601.2 | 272.9 | 346.8 | 271.2 | 304.3 | 270.5 | 303.5 | 267.6 | 297.6 | 272.3 | 305.9 |
| Total travel time [hours] HOV | 81.8 | 109.1 | 75.9 | 90.0 | 75.4 | 84.8 | 76.4 | 86.0 | 71.8 | 80.1 | 75.9 | 85.5 |
| Total travel time [hours] Trucks | 24.4 | 41.9 | 18.7 | 24.0 | 18.4 | 20.7 | 18.5 | 20.7 | 18.0 | 20.1 | 18.7 | 20.9 |
| Total travel time [hours] All Vehicle Types | 466.2 | 752.2 | 367.6 | 460.8 | 365.0 | 409.8 | 365.4 | 410.2 | 357.5 | 397.8 | 366.9 | 412.3 |

Options 1 and 2:

- Advantages:
  - HOV lane operates SB to Oakland County/Wayne County line
  - Operates within the environmentally cleared study limits
- Disadvantages:
  - Highest total travel time for all vehicles with Option 1
  - Creates weave of HOV vehicles back into the SB general purpose lanes at the lane drop from four lanes to three lanes

Options 3, 4, and 6:

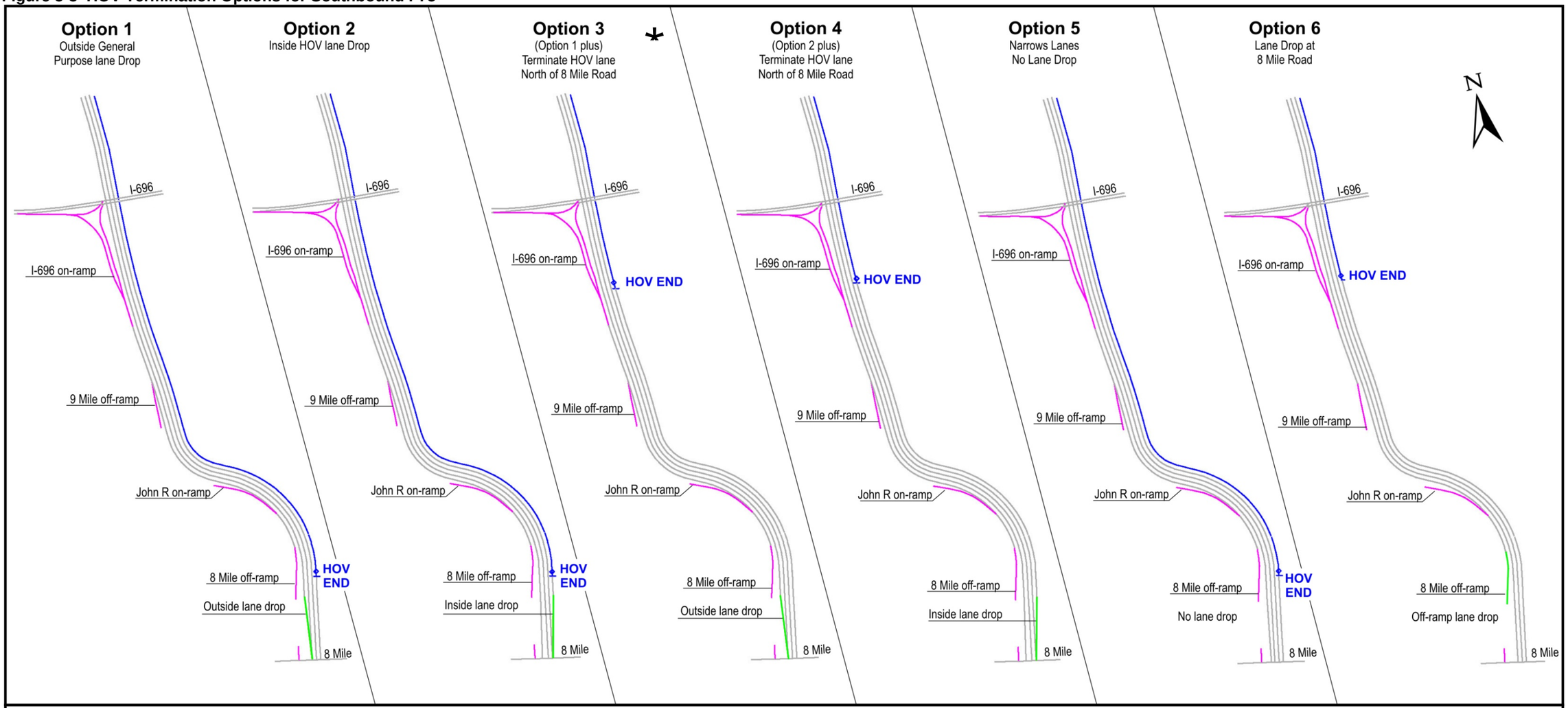
- Advantages:
  - HOV lane ends just south of I-696, and uses the upstream exclusive off–ramps at 9 Mile Road and 8 Mile Road to transition both HOV and general purpose lane users into existing three lanes at 8 Mile Road with the ramp drop
  - Operates within the environmentally cleared study limits
  - Allows merging of HOV and general purpose traffic to occur earlier upstream with overall less costs, confusion, and turbulence
- Disadvantages:
  - None

Option 5:

- Advantages:
  - Eliminates expected system-level bottleneck at 8 Mile Road by providing four through lanes for southbound I-75 into Wayne County and City of Detroit
  - Best performing HOV design for freeway operations, offering the most capacity, acceptable speeds, and delay for both HOV and general purpose lane users
- Disadvantages:
  - Requires construction outside of the environmentally cleared I-75 study limits by about 1,000 feet

Thus, within the environmentally cleared study limits, the southbound HOV lane is recommended to terminate south of the I-696 interchange. Option 3 is recommended due to safe HOV termination and maintaining existing traffic operations.

**Figure 5-3 HOV Termination Options for Southbound I-75**




**These graphics show the southbound lanes only. The HOV lane ends at a transition from 4 to 3 southbound lanes (except Option 5, which maintains 4 narrowed lanes).**

HOV Lane
Ramps
Lane Drop
Southbound Lanes

* = Recommended Option