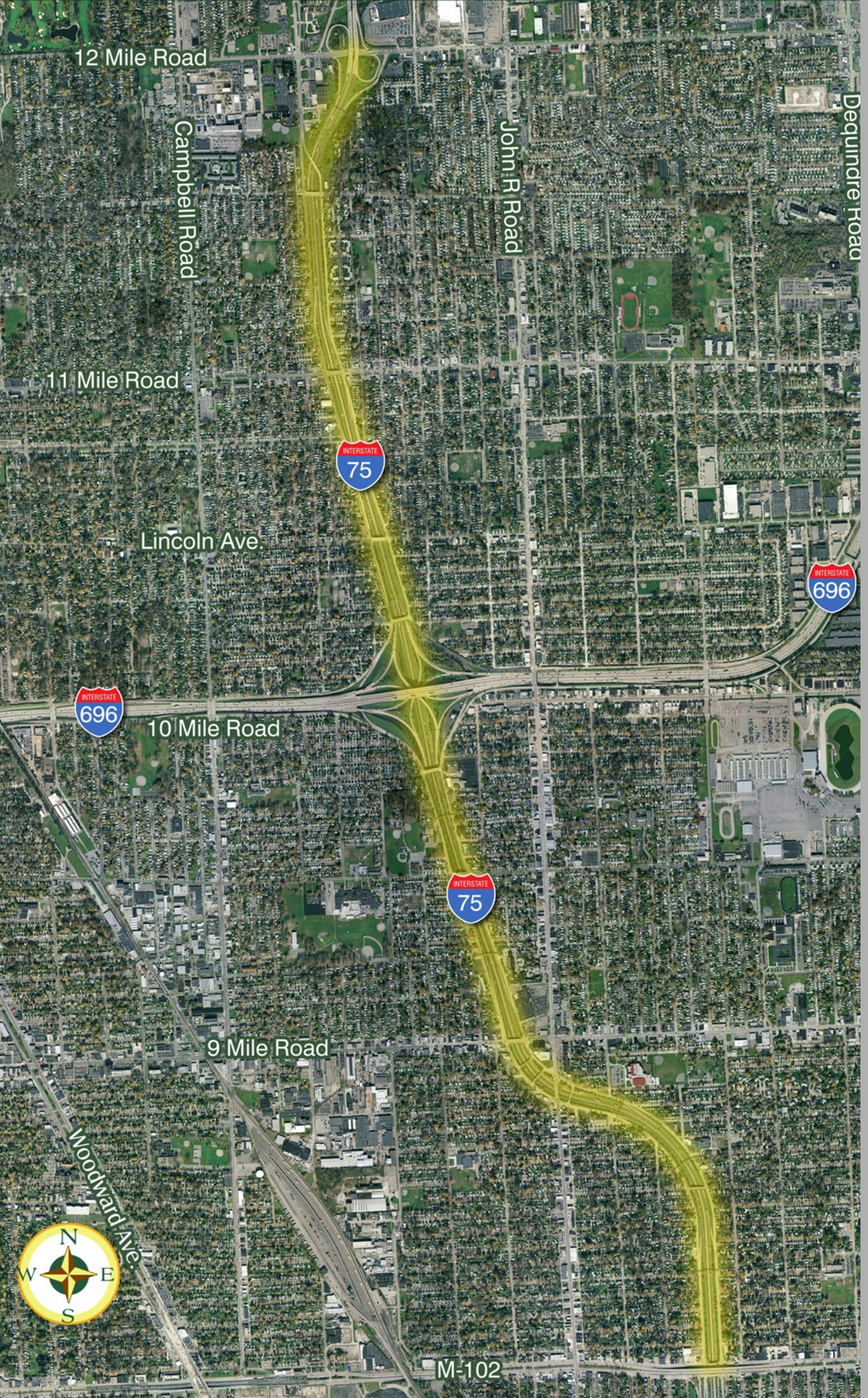


I-75 Engineering Report

M-102 to South of 12 Mile Rd

CS 63174 – JN 45700 and 100948

Appendix H
Intelligent Transportation System (ITS) Initiatives and Strategies

Submitted to:

MDOT
Michigan Department of Transportation

Michigan Department of Transportation

August, 2010

Appendix H—Intelligent Transportation System (ITS) Initiatives and Strategies

ITS is used as a cost-effective means to help better manage a region's transportation system to improve traveler and commuter safety. MDOT's ITS infrastructure in the metro region covers over 200 miles of freeway, consisting of closed circuit TV (CCTV) cameras, dynamic message signs (DMS), loop and microwave vehicle detection systems (MVDS), and environmental sensor stations (ESS).

At the core of the ITS network is a telecommunications infrastructure consisting of wireline and wireless technology. Field devices are aggregated to towers strategically located throughout the region. Node 4, 5, 7, 8, and 11 towers are connected via licensed wireless links to hub towers that reside on the network backbone. The telecommunication network backbone operates on leased fiber from Verizon (formerly MCI) with entry points at the following hub locations:

- MITS Center—1050 Sixth St. Detroit
- Hub 2—I-75 and I-696 interchange
- Hub 6—I-696 and M-10 and US-24 interchange
- Hub 9 —-I-94 and Greenfield Road
- Hub 10 —-I-96 and Greenfield Road

Figure H-1 illustrates the existing telecommunications topology and geographical footprint.

MDOT's ITS infrastructure is operated and maintained by the Michigan Intelligent Transportation Systems (MITS) Center, a traffic management center (TMC) in downtown Detroit. The MITS Center uses ITS devices to monitor roadways, manage traffic, respond to incidents, and keep motorists informed.

The following sections describe the existing ITS devices within the project limits and presents applications and technologies applicable to the roadway reconstruction.

Existing

The I-75 corridor is a mature ITS deployment, with 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 DMSs, six CCTV cameras, ten vehicle detection stations, and four environmental sensors. A combination of these ITS devices has recently been deployed in use with a curve/speed warning system approaching the 9 Mile Road curve.

Figure H-2 depicts MDOT's existing ITS field device locations. MDOT also has existing ITS device deployments farther north and south on I-75 and along I-696. In addition to each ITS field device, the site location has associated enabling infrastructure such as conduit, electrical and communication cables, handholes, cabinets, communication media (wireline and wireless), and electrical service. Table H-1 provides the conduit color guide for the telecommunications network. Table H-2 describes the device-specific details, including device type, location, current condition, communication method, and projected upgrade timeframe. Most importantly, the table also describes which of these devices will be impacted by roadway reconstruction.

Figure H-1 MDOT ITS Telecommunication Network Overview

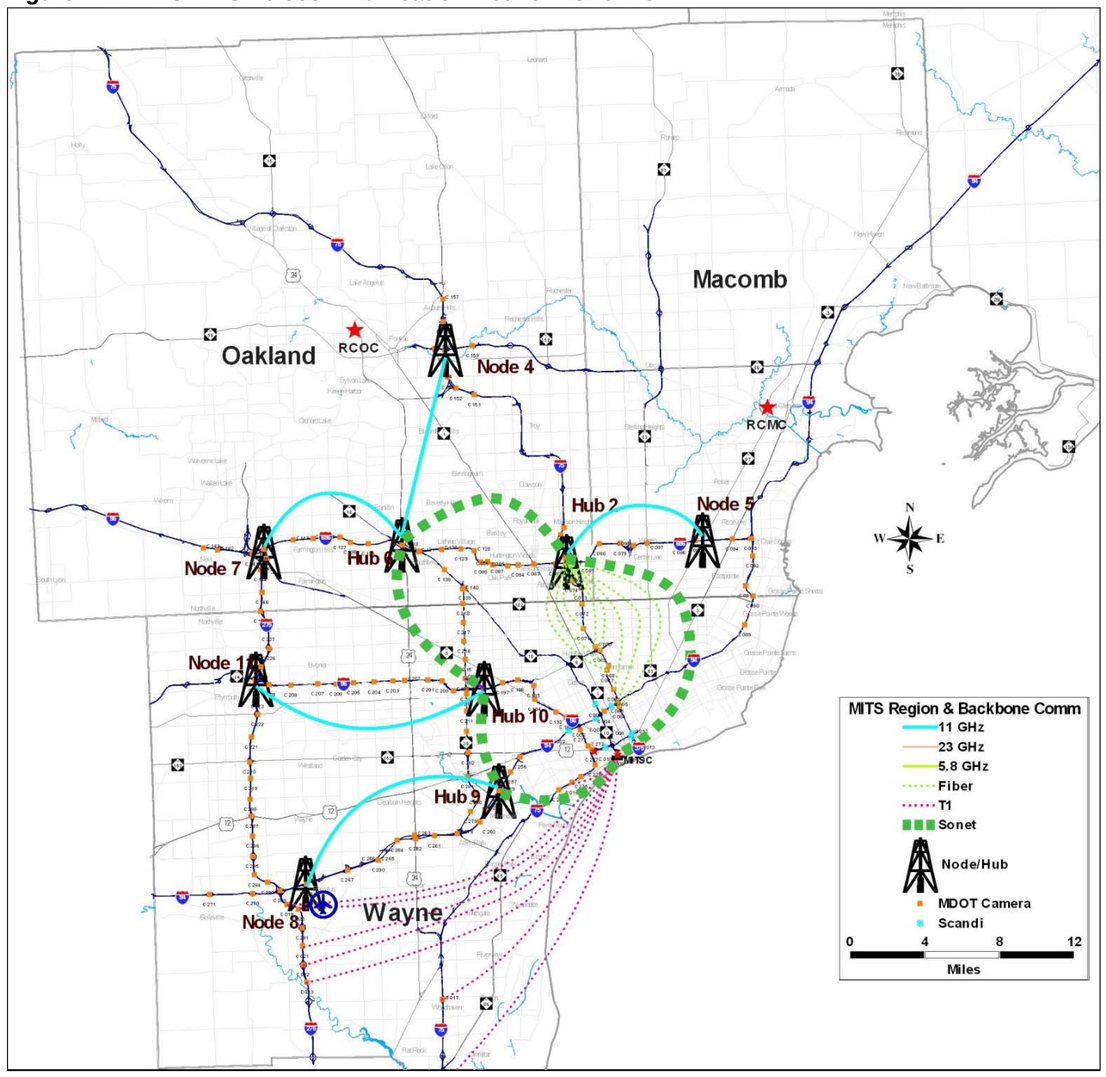


Figure H-2 ITS Field Device Locations within Project Limits

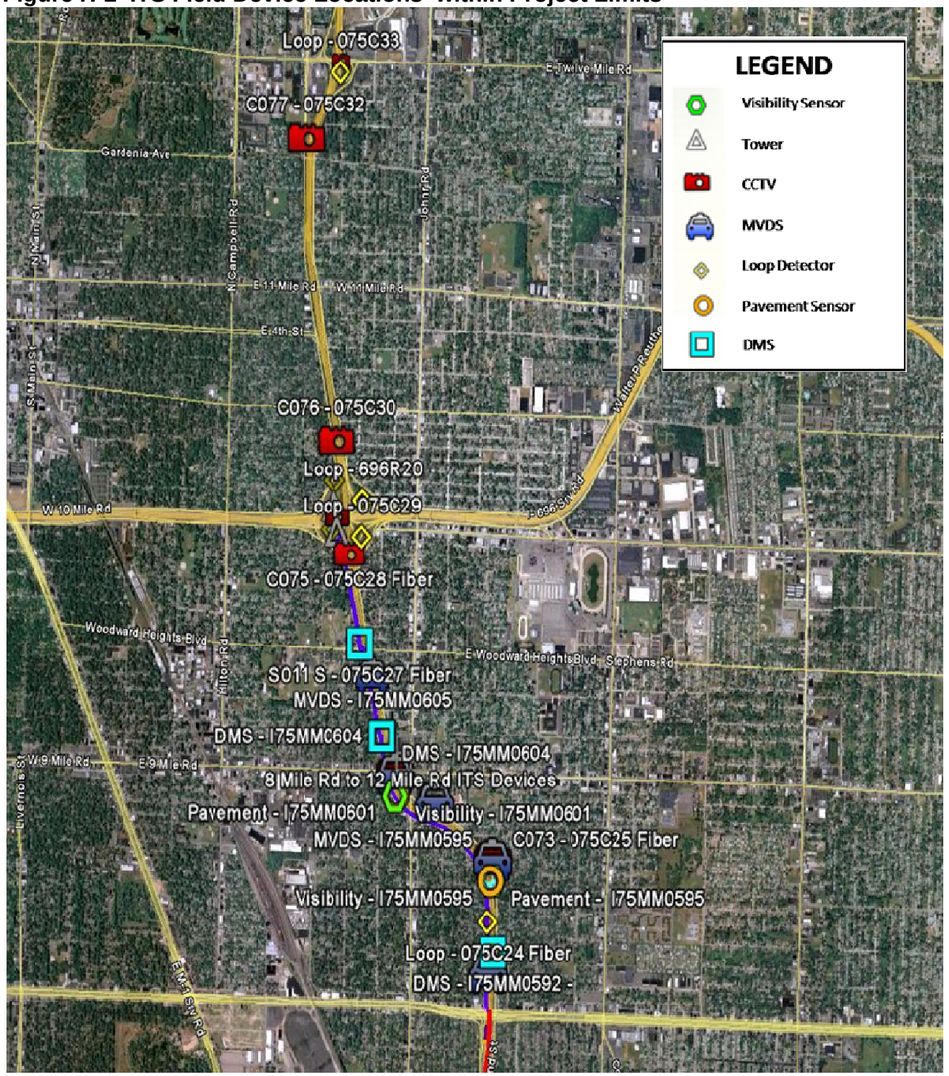


Table H-1 Conduit Color Guide for Figures H-4 through H-16

CONDUIT COLOR	QUANTITY - SIZE
Baby Blue	1-1”
Lime Green	1-2”
Orange	1-3”
Brown	1-4”
Pastel Blue	2-1½”
Lavender	2-2”
Blue	2-3”
Mint	2-4”
Purple	3-3”
Pastel Orange	4-1”
Red	4-3”
Pastel Pink	5-2”
Yellow	5-3”
Black	6-3”
Light Green	9-3”
White	10-3”
Pink	MCI Conduit

Conflicts

The proposed construction will result in several conflicts with the existing ITS infrastructure. Listed below are details about each conflict identified in Table H-2 resulting from the new alignment plan, including conflicts with the conduit, backbone fiber, and existing ITS devices that are installed on either side of the freeway or service drive. The conflict and proposed roadway station numbers correlate to each conflict described in this section. Table H-1 provides the conduit color guide to Figures H-3 through H-15, as well as the locations of the conflicts discussed. Most conflicts are due to roadway, service drive, or conduit reconstruction.

Conflicts #1 through #8, #19, and #23 are impacted by roadway reconstruction and widening. Conflicts #9 through #15 and #27 are impacted by the reconstruction of the I-75 SB Service Drive. Conflicts #16 and #17 are impacted by the construction of new U-turn bridges on the south side of Woodward Heights Boulevard. Conflicts #18, #20 through #22, and #24 through #26 have upgrades planned in the next three years or have no roadway alignment conflicts.

Table H-2 ITS Devices and Conflicts

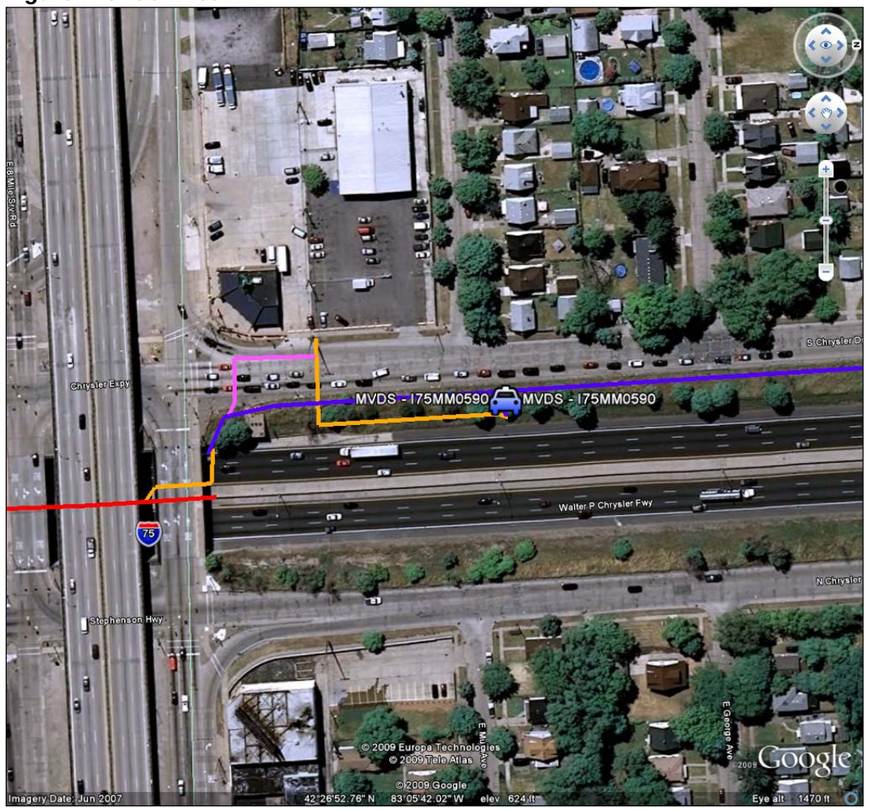
NO.	DEVICE	ROUTE	TRAVEL DIRECTION	ROADWAY STATION #	GENERAL LOCATION	CONDITION (NEW/EXISTING)	UPGRADE PLANNED	COMMUNICATION METHOD	ROADWAY ALIGNMENT CONFLICT
1	MVDS	I-75	SB	698	I-75 SB Shoulder	New		Fiber	None
2	DMS	I-75	NB	708	I-75 NB @ Bernhard Avenue	New		Fiber	X
3	Loop Detector	I-75	SB	714 / 110	I-75 SB exit Ramp to 8 Mile Road	Existing	2011	Fiber	X
4	CCTV	I-75	NB	724	I-75 NB Shoulder between Meyers Avenue and Granet Avenue	Existing	2012	Fiber	X
5	MVDS	I-75	NB	724	I-75 NB Shoulder between Meyers Avenue and Granet Avenue	New		Fiber	X
6	Visibility Sensor	I-75	NB	724	I-75 NB Shoulder between Meyers Avenue and Granet Avenue	New		Fiber	X
7	Pavement Sensor	I-75	NB	724	I-75 NB rightmost travel lane between Meyers Avenue and Granet Avenue	New		Fiber	X
8	MVDS	I-75	SB	744	I-75 SB Shoulder near Rhodes Avenue	New		Fiber	X
9	CCTV	I-75	SB	2056	I-75 SB Service Drive at Goulson Avenue	Existing	2012	Fiber	X
10	MVDS	I-75	SB	2056	I-75 SB Service Drive at Goulson Avenue	New		Fiber	X
11	Visibility Sensor	I-75	SB	2056	I-75 SB Service Drive at Goulson Avenue	New		Fiber	X
12	Pavement Sensor	I-75	SB	756	I-75 SB rightmost travel lane near Goulson Avenue	New		Fiber	X
13	DMS	I-75	SB	769	I-75 SB over travel lanes at Breckenridge Street	New		Fiber	X
14	DMS	I-75	SB	769	I-75 SB over travel lanes at Breckenridge Street	New		Fiber	X
15	MVDS	I-75	SB	516	I-75 SB shoulder near Sonoma Avenue	New		Fiber	X
16	DMS	I-75	NB	788	I-75 NB at Woodward Heights Blvd	Existing	2010	Fiber	X
17	DMS	I-75	SB	790	I-75 SB at Woodward Heights Blvd	Existing	2010	Fiber	X
18	CCTV	I-75	SB	808	I-75 SB, entrance ramp from 696	Existing	2012	Fiber	None
19	Loop Detector	I-75, I-696E, I-696W	NB	814	I-75 NB at 696 Interchange. I-696W and I-696E entrance ramps	Existing	2011	Wireless	X
20	Tower	I-75, I-696	NW	N/A	NE Quadrant of I-75 and 696 Interchange, new 350' Tower	New	2009	Wireless/Fiber	X (backbone fiber/conduit route only)
21	CCTV	I-75, I-696	NW	N/A	On Hub 2 Tower (2 CCTVs)	Existing	2012	Direct	None
22	Loop Detector	I-75, I-696	SW	N/A	SW Quadrant of I-75 and I-696, I-75NB and I-75SB entrance ramps from I-696E	Existing	2011	Fiber	None
23	Loop Detector	I-696	WB	1804	I-75NB entrance ramp from I-696W	Existing	2011	Wireless	X
24	Loop Detector	I-75	SB	898	I-75SB exit to I-696	Existing	2011	Wireless	None
25	CCTV	I-75	SB	903	I-75SB exit to I-696	Existing	2012	Wireless	None
26	CCTV	I-75	SB	899	I-75 SB at Gardenia Avenue	Existing	2012	Wireless	None
27	Conduit	I-75	SB	695-828	I-75 from M-102 to Tower 2	Existing		Fiber	X

MVDS = Microwave Vehicle Detection System; DMS = Dynamic Message Signs; CCTV = Closed Circuit Television; SB = southbound; NB = northbound; N/A = Not Applicable

CONFLICT #1: STA 694+60.80 TO STA 707+00

- Impacts to existing MITS 1-3'' conduit run under M-102 and across I-75 SB—fiber inside of conduit at this location interconnects field devices and Hub 2 to MITS Center in Detroit

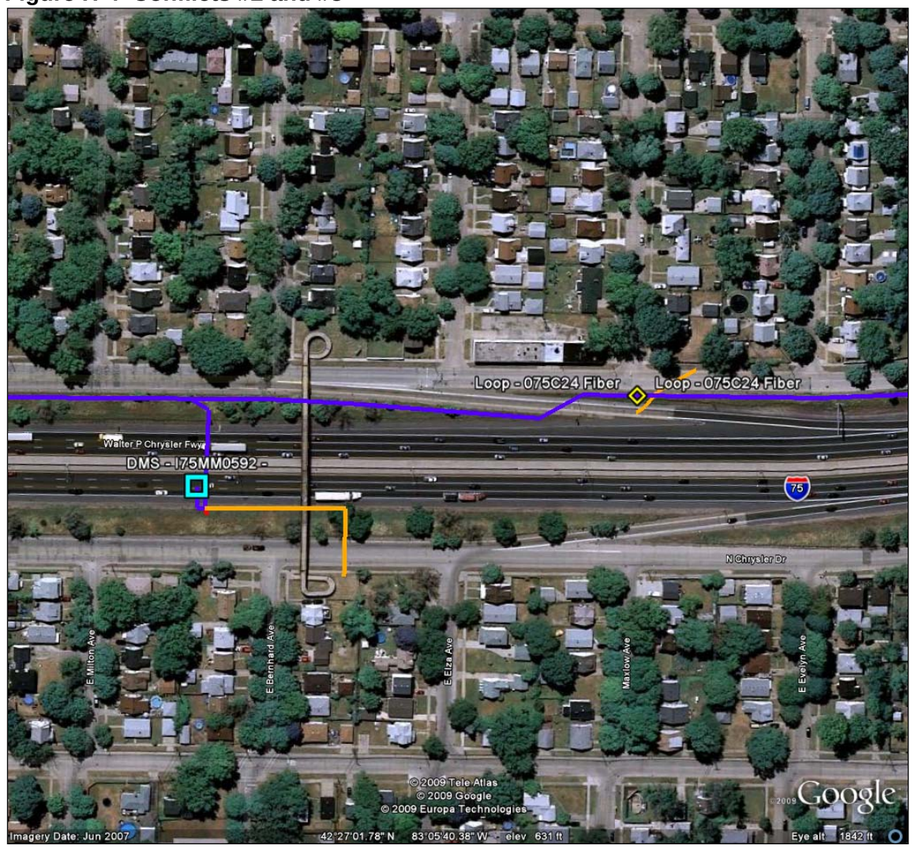
Figure H-3 Conflict #1



CONFLICTS # 2 and # 3: STA 707+00 TO 719+00:

- DMS installation on I-75 NB at MM0592. Truss mounted over NB I-75
- 2-3'' conduit from edge of NB I-75 shoulder to SB-75 shoulder (fiber interconnects DMS to core infrastructure)
- 1-3'' conduit along NB-75 between Bernhard Avenue and Elza Avenue (power to DMS)
- 1-3'' conduit from edge of NB-75 shoulder to NB service drive (power service)
- ITS cabinet installation at base of DMS truss. Conduit 4-3'' installation
- MITS 2-3'' conduit run on SB-75 shoulder, crosses exit ramp for 8 Mile Road—fiber interconnects field devices and Hub 2 to MITS Center in Detroit
- Existing loop detector 075C24 is currently detecting the exit ramp for 8 Mile Road. The proposed construction will shift the exit ramp away from the existing alignment.

Figure H-4 Conflicts #2 and #3



CONFLICTS # 4 through- # 7: STA 719+00 TO STA 731+00

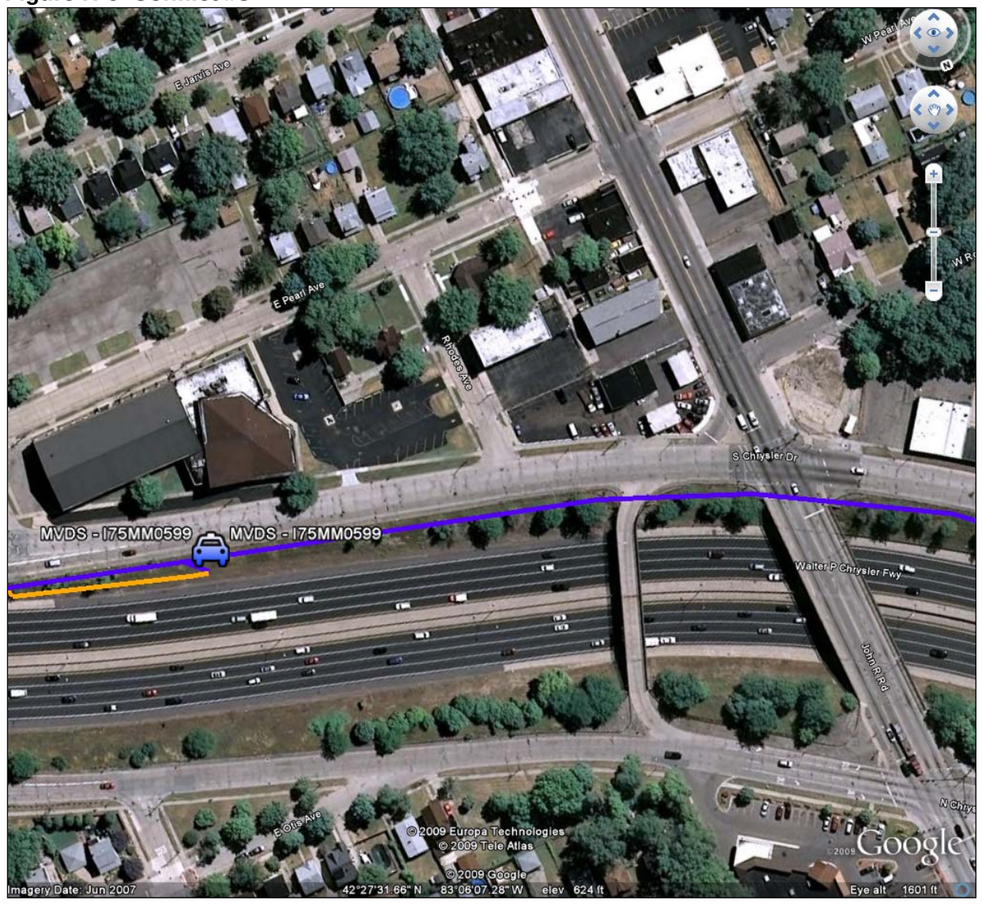
- Existing CCTV pole co-located with a MVDS and a visibility sensor on I-75 NB shoulder between Meyer Avenue and Granet Avenue
- Existing CCTV pole is currently located at proposed barrier wall on the I-75 NB shoulder
- Pavement sensor and 1-3'' conduit installed on I-75 NB rightmost travel lane
- MITS 1-1'' conduit from CCTV pole across I-75 travel lanes to SB I-75 shoulder. Interconnects field devices to DMS.
- Existing 2-3'' MITS conduit is currently located at the proposed barrier wall on the I-75 SB shoulder at Madge Avenue. Fiber interconnects field devices and Hub 2 to MITS Center in Detroit.

Figure H-5 Conflicts #4 through #7

CONFLICT #8: STA 743+00 TO STA 755+00

- Existing 2-3'' MITS conduit along I-75 SB shoulder. Fiber interconnects field devices and Hub 2 to MITS Center in Detroit.
- Proposed reconstruction of the I-75 SB service drive will impact the 2-3'' MITS conduit along I-75 SB service drive starting from Rhodes Avenue to Otis Avenue
- MVDS installed on steel pole on I-75 SB shoulder at Highland and Rhodes Avenues
- Existing 2-3'' conduit from pole to MITS handhold along SB shoulder
- Existing 1-3'' conduit to wood utility pole at Highland Avenue

Figure H-6 Conflict #8



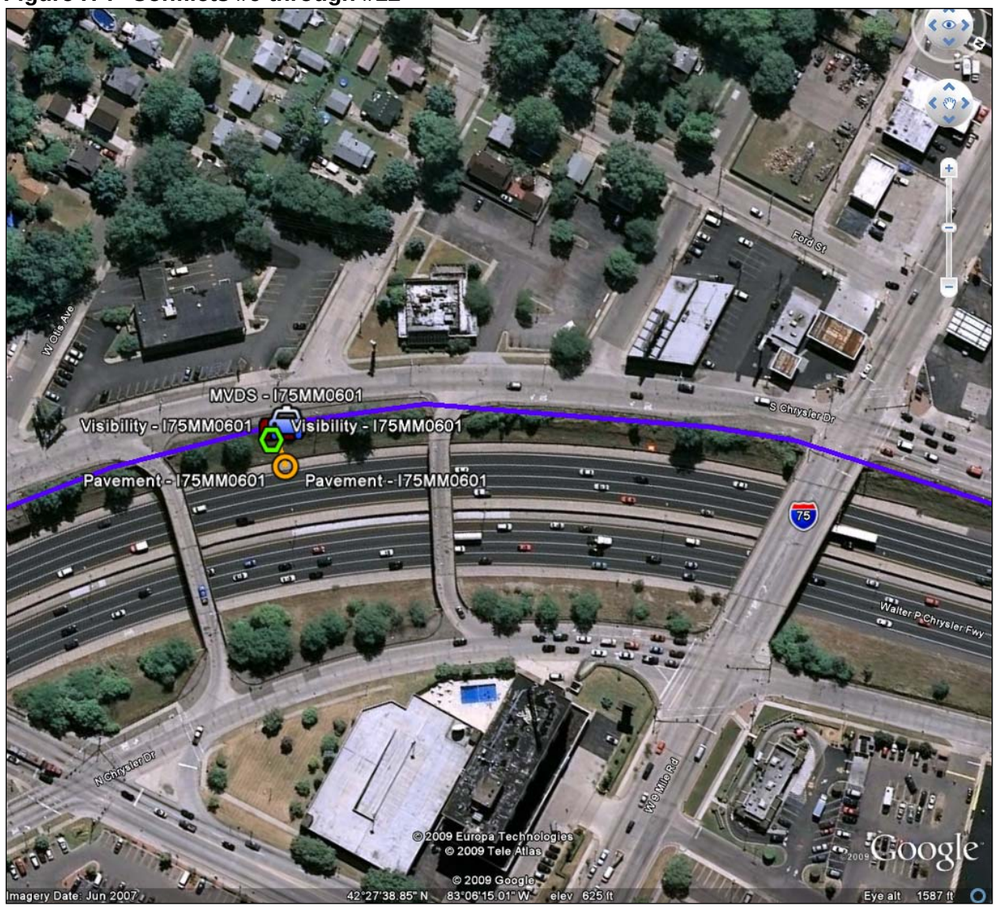
CONFLICTS # 9 through # 12: STA 755+00 to STA 767+00

- Existing 2-3'' MITS conduit on I-75 SB service drive—fiber interconnects field devices and Hub 2 to MITS Center in Detroit
- Existing CCTV pole co-located with a MVDS and a visibility sensor on I-75 SB service drive
- Existing 2-3'' MITS conduit between pole and MITS handhole. Interconnect devices to DMS at Breckenridge Street

Proposed roadway construction (new alignment) will impact the following:

- Pavement sensor and 1-3'' conduit installed on I-75 SB rightmost travel lane

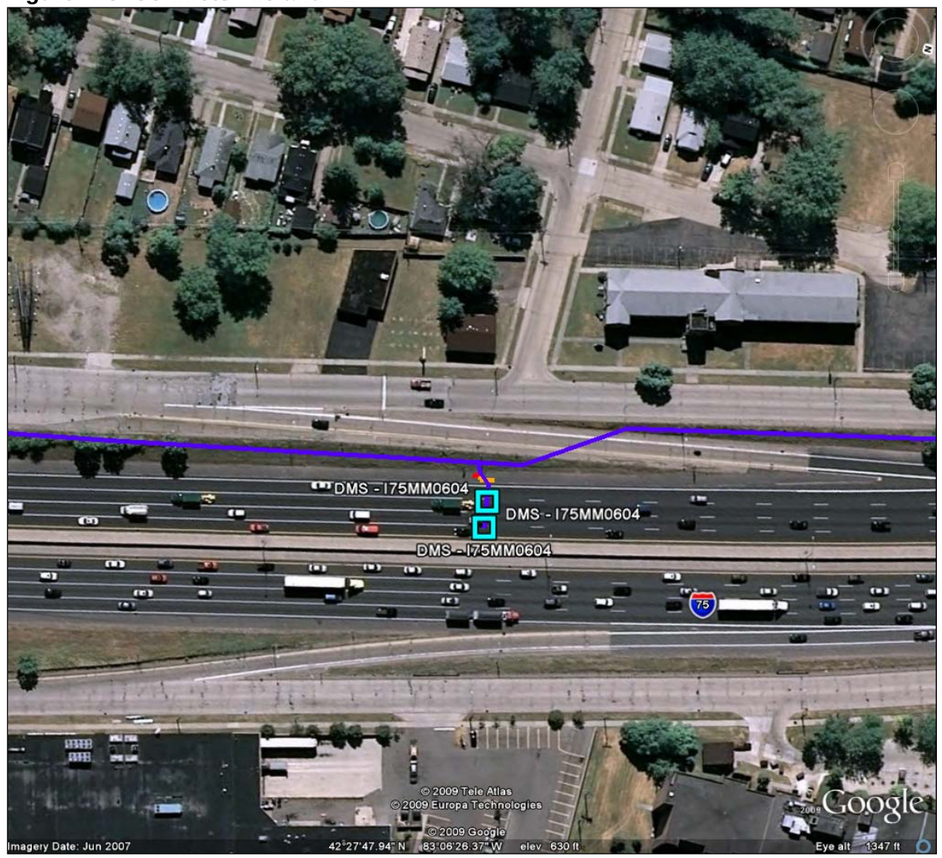
Figure H-7 Conflicts #9 through #12



CONFLICTS # 13 and # 14: STA 767+00 TO 779+00:

- Existing 2-3'' MITS conduit on I-75 SB service drive—interconnects field devices and Hub 2 to MITS Center in Detroit
- Existing 2-3'' MITS conduit crosses existing exit ramp at Breckenridge Street
- Existing DMS truss mounted over I-75 SB
- Existing 2-3'' conduit from DMS (shoulder of I-75SB) to MDOT handhole
- Existing wood pole on edge of I-75 SB shoulder for power service to DMS and ITS cabinet
- Existing ITS cabinet on I-75 SB shoulder and 4-3'' conduit to MDOT handhole
- Existing 2-3'' conduit from MDOT handhole to MITS handhole

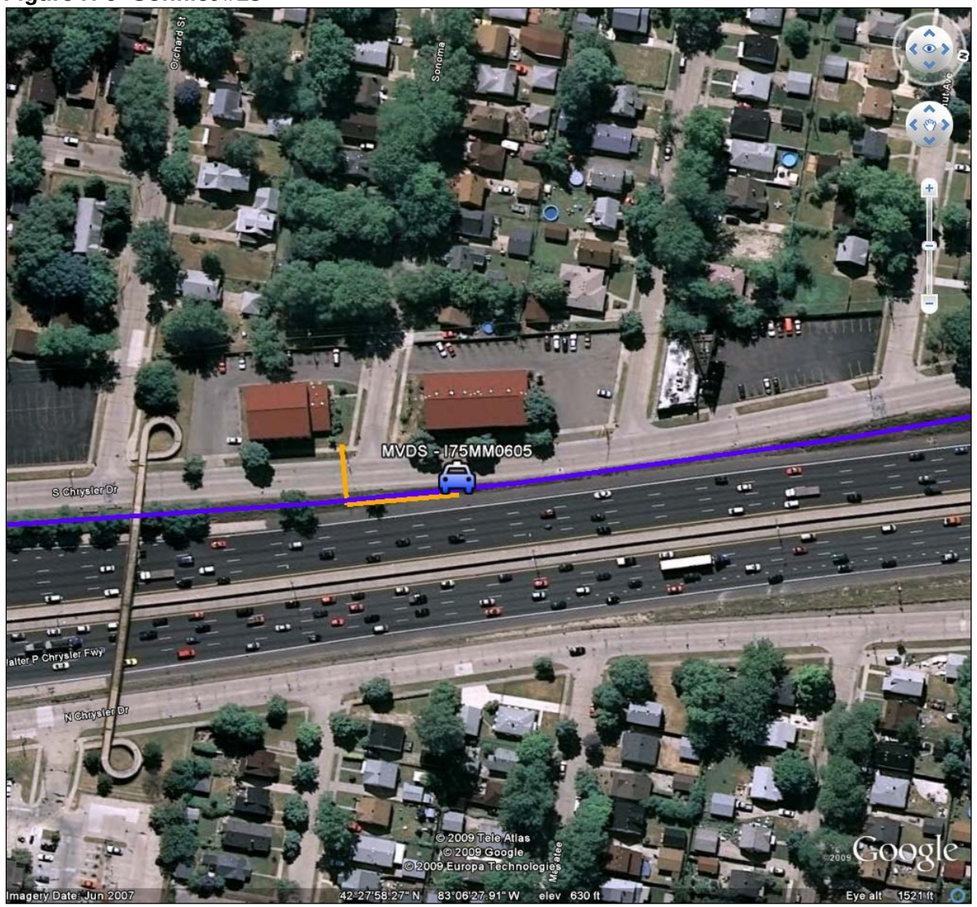
Figure H-8 Conflicts #13 and #14



CONFLICT # 15: STA 779+00 TO STA 791+00:

- Existing 2-3'' MITS conduit on I-75 SB service drive—interconnects field devices and Hub 2 to MITS Center in Detroit
- Existing 1-3'' conduit across the service drive at Sonoma Street
- Existing MVDS on I-75 SB shoulder
- 2-3'' conduit from MVDS to MITS 2-3'' conduit on service drive
- 1-3'' conduit from MVDS to handhole for utility service
- Existing 2-3'' MITS conduit currently located at proposed barrier wall

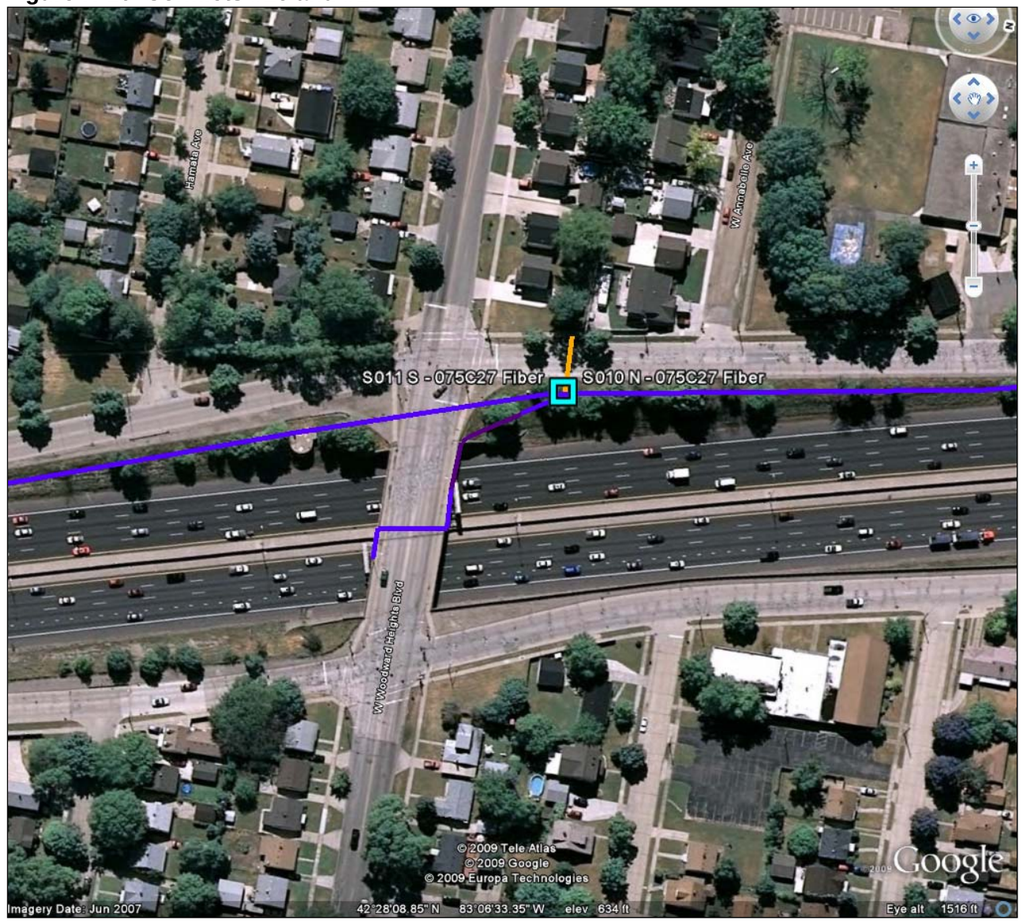
Figure H-9 Conflict #15



CONFLICTS # 16 and # 17: STA 779+00 TO STA 791+00:

- DMSs truss mounted at Woodward Heights Boulevard
- 2-3'' conduit running along Woodward Heights Boulevard from each DMS to an ITS cabinet on the SB I-75 service drive

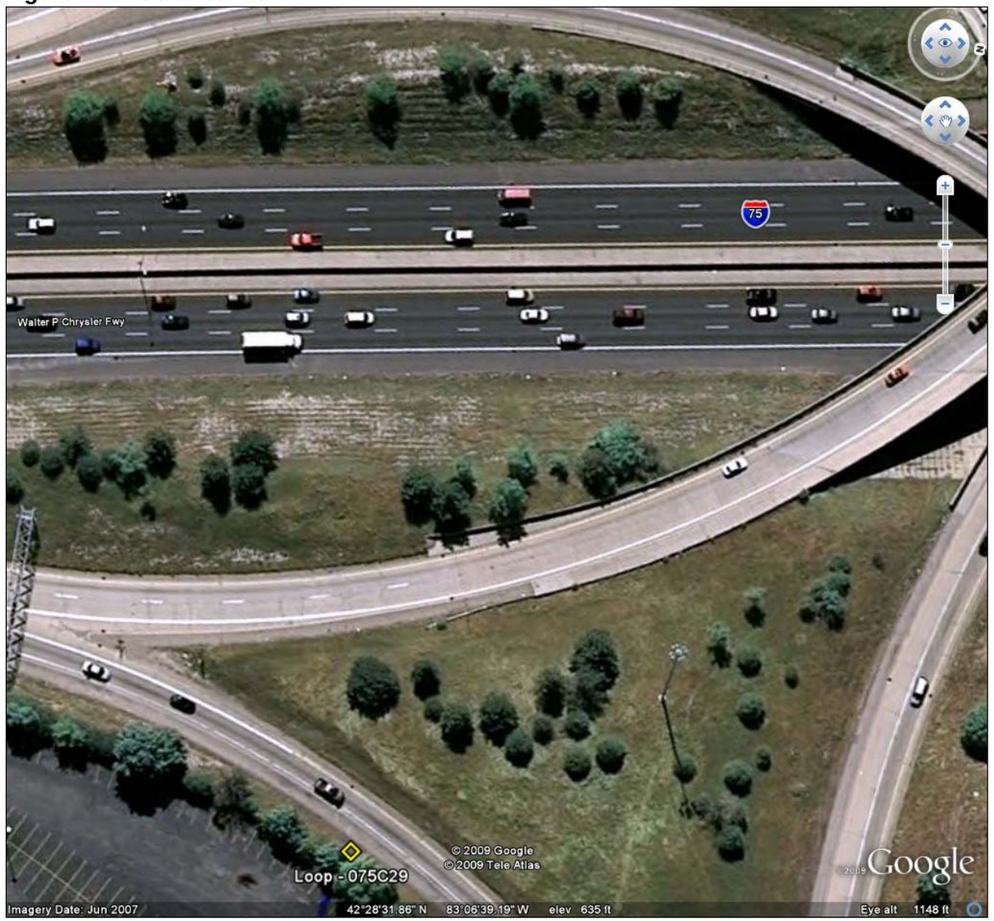
Figure H-10 Conflicts #16 and #17



CONFLICT # 19: STA 803+00 TO STA 815+00

- Loop detector on I-75 NB lanes
- 1-2'' conduit from loop detector to cabinet
- Loop detector on I-75 NB ramp to I-696 W
- 1-2'' conduit to cabinet
- Connector loop on I-75 NB ramp to I-696 E
- 1-2'' conduit to cabinet

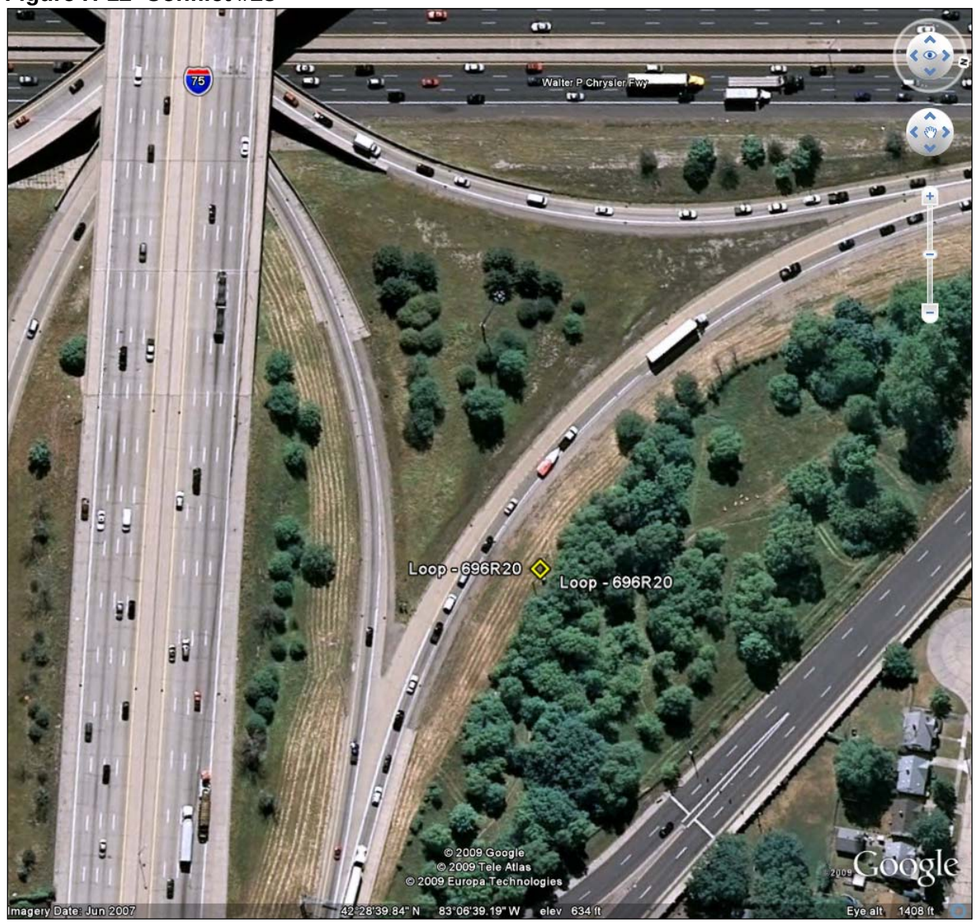
Figure H-11 Conflict #19



CONFLICT # 23: STA 815+00 to STA 827+00

- Loop detector on I-696 EB ramp to I-75 NB
- 1-2'' conduit from loop detector to ITS cabinet

Figure H-12 Conflict #23



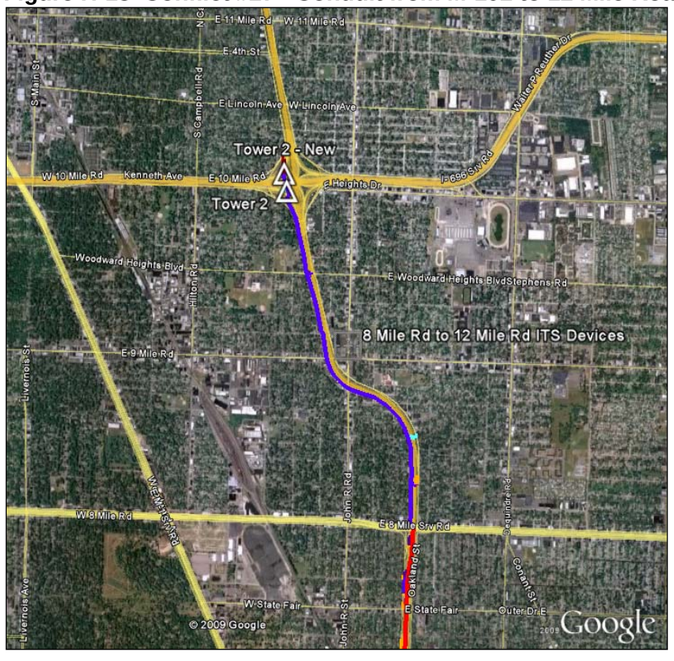
CONFLICT #27: Hub 2 Conduit and Leased Fiber

One of the key elements of MDOT's ITS infrastructure is the leased communication backbone fiber and conduit plan. Figure H-13 depicts the planned conduit, which connects to Hub 2 and ITS field devices. The conduit contains MDOT-owned fiber used for ITS field device connections and Verizon-leased fiber that is used for the communication backbone. This conduit and fiber are primarily installed on SB I-75 up to the I-696 interchange and will be impacted by road reconstruction.

The Hub 2 tower is currently being upgraded to a new 350-foot tower and being moved from the southwest quadrant to the northwest quadrant of the I-75 and I-696 interchange. At present, there are no known conflicts with the new tower and shelter location. Hub 2 is a critical part of the network—not only is it an aggregation point for locally installed ITS devices along I-75 and I-696, it is also the connection point for Node 5 into the network backbone. Node 5 is connected to Hub 2 via a licensed wireless backhaul link and is the aggregation point for locally installed field devices along I-94 and I-696.

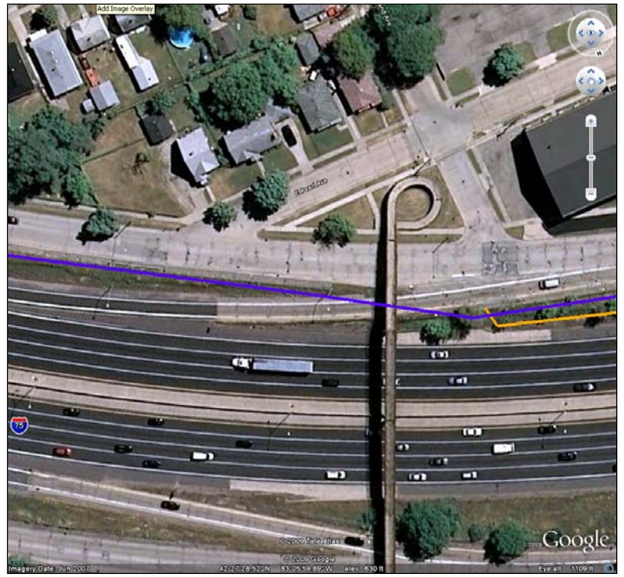
The MITS Center in Detroit uses these ITS devices and information to dispatch emergency responders, disseminate information to motorists, and monitor the road/weather conditions of critical interchanges. ITS infrastructure, specifically the backbone fiber, in this corridor is critical to operations and must be maintained during road reconstruction. It is highly recommended that a migration strategy be developed before any construction begins.

Figure H-13 Conflict #27 - Conduit from M-102 to 12 Mile Road



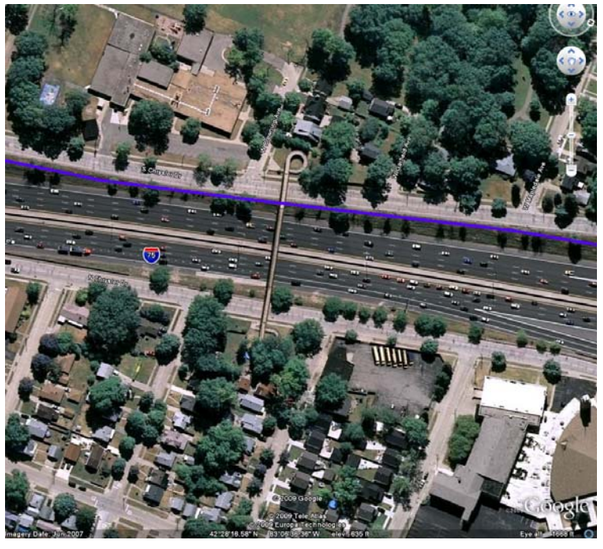
STA 731+00 TO STA 743+00: 2-3'' MITS conduit on I-75 SB shoulder at Highland Avenue and Pearl Avenue: Conduit crosses existing I-75 SB entrance ramp and continues along I-75 SB shoulder. Fiber interconnects field devices and Hub 2 to MITS Center in Detroit. A new wood utility pole is needed on the I-75 SB shoulder for new curve warning system. 1-3'' conduit will run from the utility pole to MVDS along the shoulder. See Figure H-14.

Figure H-14 Conflict #27 STA 731+00 TO STA 743+00



STA 791+00 to STA 803+00: Existing 2-3'' MITS conduit on I-75 SB shoulder is located at a new proposed barrier wall—fiber in conduit interconnects field devices and Hub 2 to MITS Center in Detroit. See Figure H-15.

Figure H-15 Conflict #27 STA 791+00 to STA 803+00



Recommendations

Several ITS components and existing infrastructure will be impacted with the new roadway alignment. With any new roadway construction where ITS will be deployed or is currently deployed, it is important to evaluate new and improved modifications to the system. The following are general actions that can be taken to build redundancy and provide core infrastructure to expand ITS infrastructure:

- Build new conduit in both directions of travel along I-75 up to the I-75/I-696 interchange: MDOT has its own 2-to-3-inch conduit up to Hub 2 at the I-75/I-696 interchange interconnecting all field devices and core infrastructure through the corridor. The conduit currently resides on the I-75 SB shoulder or service drive and has junction points to connect devices that are on the NB shoulder. By expanding to the I-75 NB service drive, an alternate path is created for devices on the opposite side of the roadway to be connected at Hub 2. Additionally, installation of new 2-to-3-inch conduit (at a minimum) can serve as a back-up route for all cabling to and from Hub 2 if that run becomes inoperable.
- Build new conduit (both directions of travel) north of the I-75/I-696 interchange: All devices in this corridor are currently interconnected back to Hub 2 via wireless links. Expansion of the conduit from Hub 2 to 12 Mile Road would provide MDOT with the ability to run new fiber to all existing devices and eliminate the antiquated wireless links. This would improve reliability and lifespan for the interconnection.

If conduit is installed in both directions of travel, main conduit interconnects should also be installed at key junction points, or at a minimum every mile segment. At a minimum, handholes should be installed every 400 feet for pulling and conduit access points. Device-specific site needs may warrant additional conduit connections and handholes for pulling tensions, power service, and access to cabinet locations. Coordination of conduit installation with MDOT Freeway Lighting may be beneficial to both parties.

ITS Work-Zone Considerations

ITS infrastructure will be severely impacted by the new roadway plan. Devices along I-75, I-696, and Node 5 use Hub 2 as an aggregation point to send data downstream to the MITS center. The fiber that runs through the conduit along the I-75 corridor will require a plan to avoid any disruptions of service. The following are a subset of recommendations and considerations to keep the ITS functionality intact and identify necessary components that should be operational during construction. These same ITS devices could be used to assist with work zone traffic control during construction.

Keep MDOT Fiber connection from Hub 2 to MITS Center Undisturbed

To avoid any disruptions, a migration strategy or a temporary plan must be in place to keep the communication line intact. The fiber connection in the MDOT-owned conduit can remain intact by using the following methods.

- Aerial Fiber—use temporary utility poles to re-route fiber connection overhead in impacted construction zones
- Phased Construction Approach—build one side of the new freeway at a time to allow the existing conduit and fiber to be used while building I-75 NB with new conduit and then re-routing the fiber before building I-75 SB
- Keep CCTV and strategic DMS active during construction, whenever possible
- Seven CCTV cameras monitor roadways from the MITS Center and should be maintained in work zones to provide additional visibility to traffic conditions and to monitor work zone safety. The use of DMS will provide motorists with key information for detour routes and lane or highway closures in other corridors beyond 12 Mile Road and M-102. If specific locations are not able to be kept operational or a more desirable device placement is required during construction, the use of temporary work zone ITS devices could be used to supplement gaps in coverage.

Enhancements to Existing ITS Infrastructure

Due to limitations and interoperability issues between the existing ITS devices and the new Ethernet-based communication system and Advanced Traffic Management Systems (ATMS) software platforms, some if not all, of these devices will need to be upgraded. In the interim to address these types of issues, MDOT is implementing protocol translators for the legacy DMS, upgrading communication links to Ethernet technology, and using a dual backbone architecture to enable use of the new and legacy ATMS platforms simultaneously until all antiquated ITS devices and technology are replaced. Table H-2 shows MDOT has already upgraded about half of the ITS devices within the project limits to newer technology. This roadway reconstruction presents an ideal opportunity to upgrade the remaining ITS devices and communication links to ensure seamless integration into MDOT's new Ethernet-based telecommunication network and statewide ATMS software platform.

MDOT currently has a "Device Upgrade" project that includes replacement of these types of antiquated links and devices, which should be coordinated with this reconstruction project based on overall schedules. The following are recommendations to enhance the ITS devices along the I-75 corridor with the understanding that these issues have not been resolved prior to commencement of this reconstruction project:

Upgrade Analog/Serial Communication Links

Some existing wireless communication links use antiquated technology or equipment. Some equipment is no longer cost-effective to maintain or has very limited availability for spare parts. In addition, these communication links present issues for existing ITS devices being able to establish communication with the new ATMS software platforms (discussed below) and Ethernet-based communications. The existing DMS signs need to be replaced with newer DMS technology

The existing DMS signs at Woodward Heights Boulevard need to be replaced with newer DMS signs with full LED-pixel technology and full NTCIP compliance to seamlessly integrate with the new ATMS. However, at a minimum the communications technology should be upgraded to allow for the use of the Ethernet-based protocol converters, which will enable communication interoperability between these legacy DMS and the new ATMS. Based on available funding, replacing DMS north and south of the project limits should be considered.

The legacy loop detectors need to be replaced with newer vehicle detection systems. All the legacy loop detector stations need to be replaced with newer technology similar to the Microwave Vehicle Detection Systems, Wireless Pavement Sensors, or Magnetometers to continue capturing vehicle information such as speed, occupancy, classification, and count. This is also necessary due to interoperability with the new ATMS software platforms and protocols used.

Upgrade Legacy CCTV Cameras

The existing legacy CCTV cameras need to be replaced with newer technology and full NTCIP compliance to seamlessly integrate with the new ATMS. At a minimum, the communications technology should be upgraded to newer Ethernet-based communication with the ATMS for maintenance. Based on available funding, the CCTV cameras north and south of the project limits should be considered for replacement.

Additional Operational Recommendations

In addition to managing work-zone traffic control and enhancing existing devices for the proposed roadway construction, the following ITS-related solutions can be implemented to help reduce crashes and congestion. These advanced technology solutions can also provide additional information to MDOT

and partner agencies about existing roadway conditions and enhance their ability to make decisions for incident response.

- Road Weather Information System (RWIS), Environmental Sensor Station (ESS): A RWIS consists of remote sensing locations that together form an information system to gather and transmit road-related weather information. Future enhancements for weather-related sensing technology should be considered.
- Additional curve/speed warning systems: Curve locations along the I-75 corridor north and south of the project limits could benefit from implementation of a curve speed warning system. Additional warning systems at these locations could be similar to those used at 9 Mile Road to help reduce vehicle accidents and notify motorists of up-coming road conditions.
- Ramp metering to manage traffic flow
- Managed lanes: The most common application is the use of High Occupancy Toll (HOT) lanes, where the number of cars using the reserved lanes can be controlled via electronic toll collection so as to maintain free-flowing traffic at all times, even during rush hour. This application, when used correctly, can provide superb mobility through otherwise congested corridors of freeway. Installation of such an application would require an overhead gantry at every major interchange and exit and entrance ramp to begin and end electronic tolling.
- Incident management and safety service patrols: Incident management systems enable MDOT to improve motorist safety and reduce overall travel times. At the core of an incident management system is the operations staff and some form of ATMS software platform. An automated decision support system could tie into existing and planned ITS devices to help reduce detection and dispatch times. MDOT Freeway Courtesy Patrol assisted over 35,000 stranded motorists on 12 Metro Detroit freeways in 2008, and increased surveillance and detection algorithms could help increase that number. In addition, for purposes of this project additional (dedicated) service patrols could be in place during times of heavy construction and/or expected travel problems (weather, special events, holiday travel, rush hours, etc).

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