

## Section Six North Segment

(From Silver Lake Road Interchange to I-96/US-23 Interchange)

### NORTH SEGMENT LIMITS

The limits of the North Segment are from south of the Silver Lake Interchange to south of the I-96/US-23 Interchange. This section consists of approximately 3.5 miles of freeway and includes two local interchanges and four structures. Traffic analyses were extended to north of the I-96/US-23 interchange. This segment is located in Green Oak Township and Brighton Township in Livingston County.

### PAVEMENT AND BRIDGE CONDITION

Built in the 1960s, the pavement of the north section is concrete with bituminous overlay. Most of the pavement in this section has a remaining service life of 8 to 12 years (**Figure 6-1: Pavement Conditions-Remaining Service Life**). The Ride Quality Index measures pavement roughness and is shown in **Figure 6-2: (Pavement Conditions-Ride Quality Index)** for the north segment. **Table 6-1** provides vital bridge information for the North Segment structures. Two of the four structures are currently in poor condition.

TABLE 6-1

US-23 BRIDGE STATISTICS - NORTH SEGMENT					
Facility Carried	Year Reconstructed (rehabilitated)	Overall structure Rating	Last inspection date*	Under-clearance	Structure number
CSX Railroad Overpass	1961	Fair	7/2007	15'3"L, 15'0"R	X03
Lee Road Interchange	1962	Poor	7/2007	14'9"L, 14'2"R	S04
Silver Lake Road under SB US-23	1960	Fair	7/2007	15'7"R	S03-2
Silver Lake Road under NB US-23	1960	Poor	7/2007	14'7"R	S03-1

\*As of March 2008

FIGURE 6-1

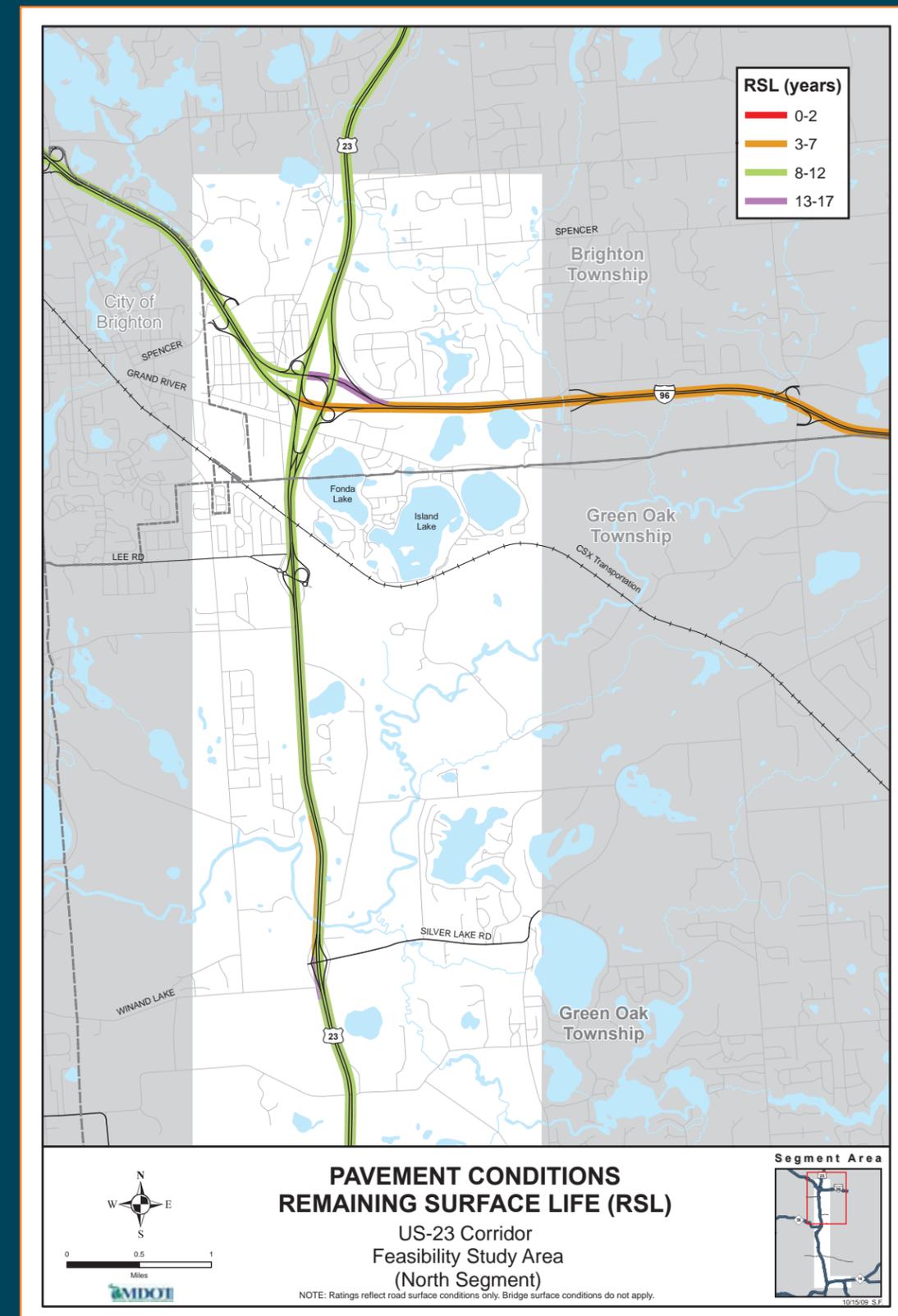
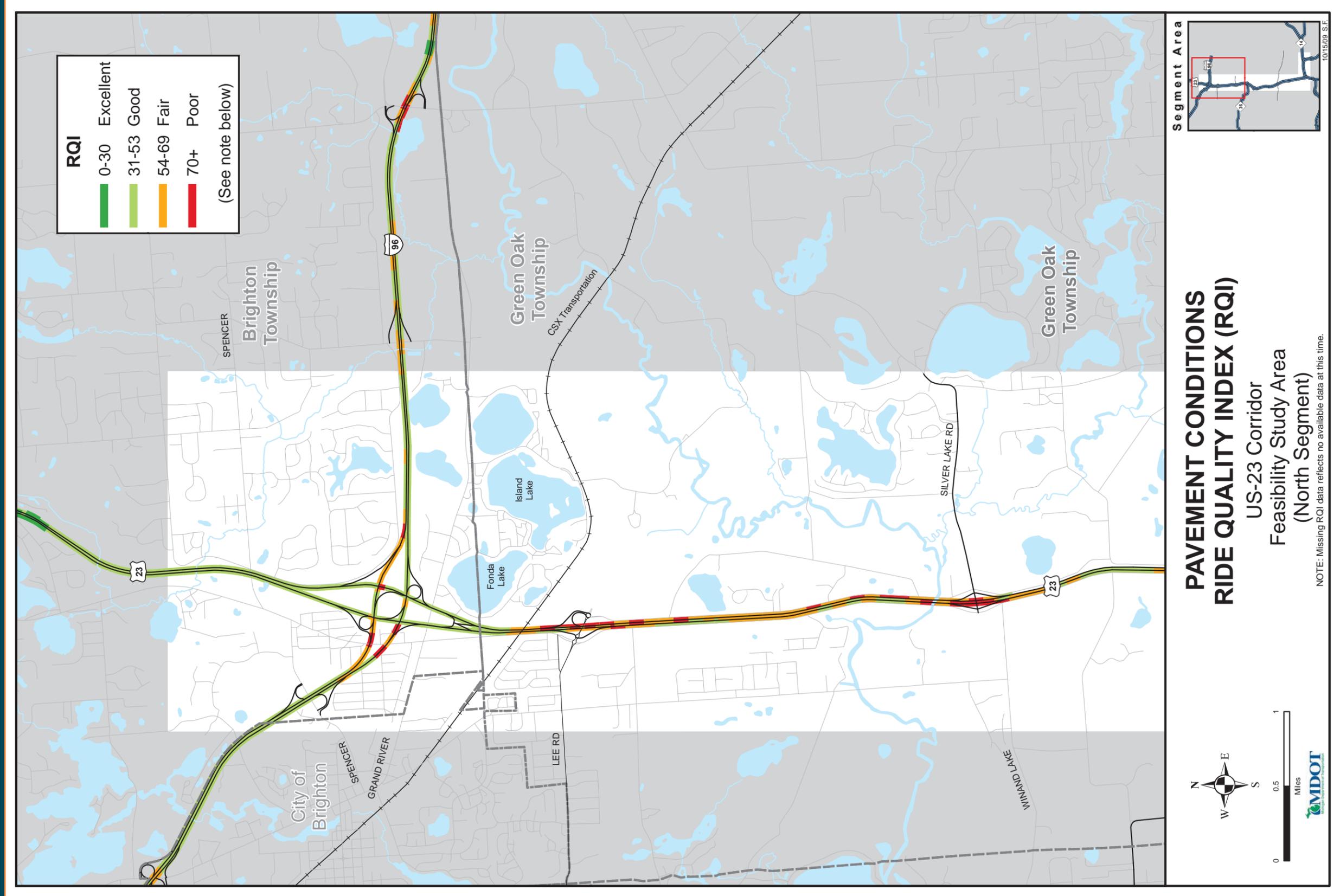


FIGURE 6-2



TYPICAL RIGHT-OF-WAY

The right-of-way width along the roadway is 150 feet along the center of the roadway. Individual interchange aerial photos located in the North Segment Structures section illustrate more detailed right-of-way information near the interchanges.

TRAFFIC CONDITIONS

2007 Freeway Segments Analyses ( Existing Conditions)

The AM Peak Hour period for the US-23 corridor between I-96 and M-14 occurs on weekdays between 7:30-8:30.

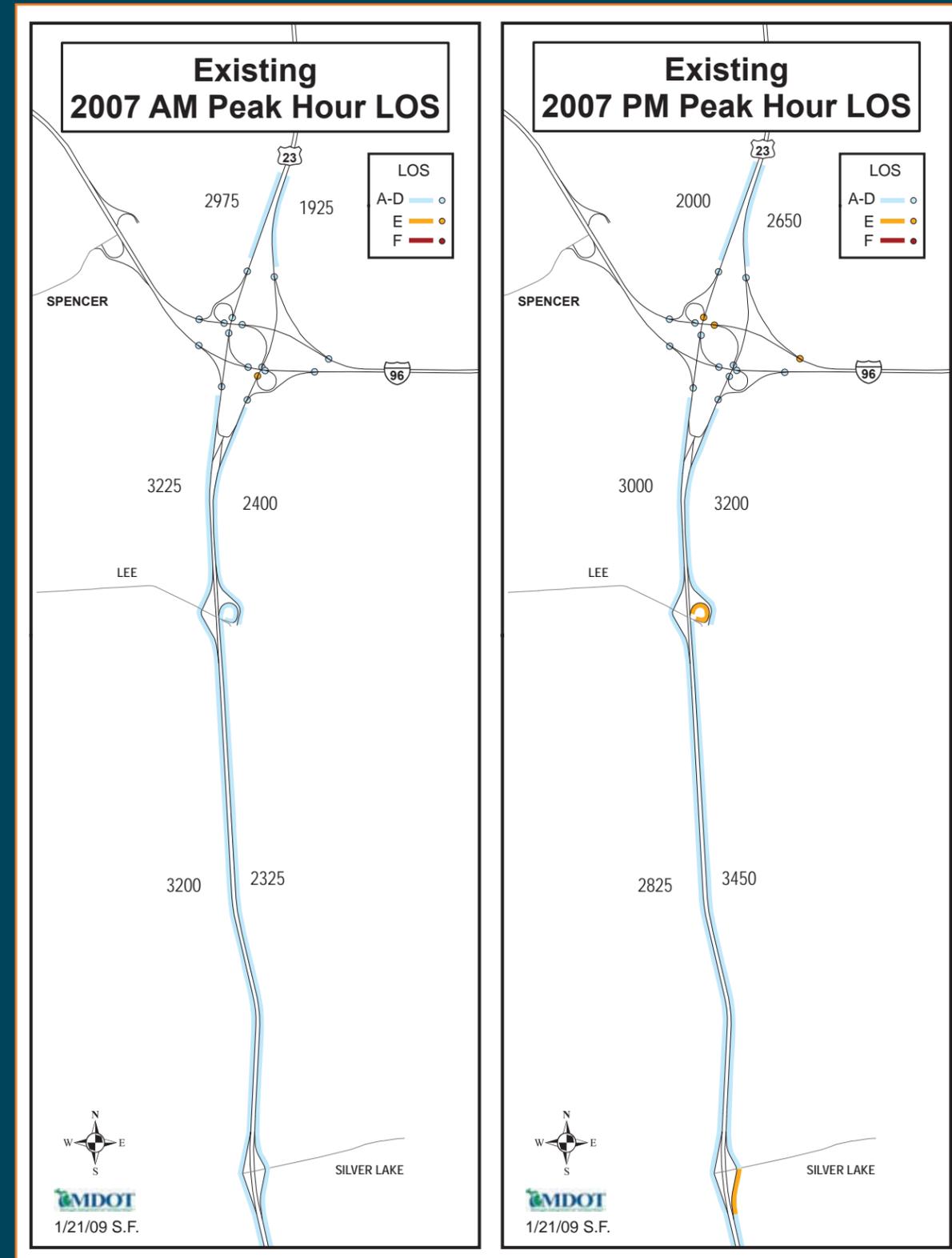
**Table 6-2** shows the US-23 AM and PM Peak Hour data on basic freeway segments for 2007 Base Year under No-Build conditions. No section of the North Segment operates at an unacceptable Level-of-Service (LOS) during the AM Peak Hour. The PM Peak Hour period for the US-23 corridor between I-96 and M-14 occurs on weekdays between 5:00-6:00. No portion of the North Segment runs at an unacceptable LOS during the PM Peak Hour. (**Figure 6-3: Existing 2007 AM/PM Peak Hour LOS**).

TABLE 6-2

EXISTING (2007) AM & PM PEAK HOURS LEVEL OF SERVICE BASIC FREEWAY SEGMENTS								
2007 Southbound US-23 AM Peak					2007 Southbound US-23 PM Peak			
Freeway Segment To/From	Volume, V	Flow Rate, Pc/hr	Density*, Pc/mi/ln	LOS	Volume, V	Flow Rate, Pc/hr	Density*, Pc/mi/ln	LOS
N of I-96 to I-96 Interchange*	2,975	1,752	25.6	C	2,000	1,178	16.8	B
I-96 Interchange to Lee Road	3,225	1,899	28.5	D	3,000	1,767	25.9	C
Lee Road to Silver Lake	3,200	1,844	28.2	D	2,825	1,664	24.1	C
Silver Lake to 9 Mile	3,250	1,914	28.9	D	2,550	1,502	21.5	C
2007 Northbound US-23 AM Peak					2007 Northbound US-23 PM Peak			
Freeway Segment To/From	Volume, V	Flow Rate, Pc/hr	Density*, Pc/mi/ln	LOS	Volume, V	Flow Rate, Pc/hr	Density*, Pc/mi/ln	LOS
9 Mile to Silver Lake	2,000	1,178	16.8	B	3,550	2,061	32.4	D
Silver Lake to Lee Road	2,325	1,369	19.6	C	3,450	2,032	31.6	D
Lee Road to I-96 Interchange	2,400	1,413	20.2	C	3,200	1,884	28.2	D
I-96 Interchange to North of I-96	1,925	1,134	16.2	B	2,650	1,561	22.4	C

\*Outside of project area

FIGURE 6-3



### 2030 Forecasted Freeway Segments Analyses (No-Build Conditions)

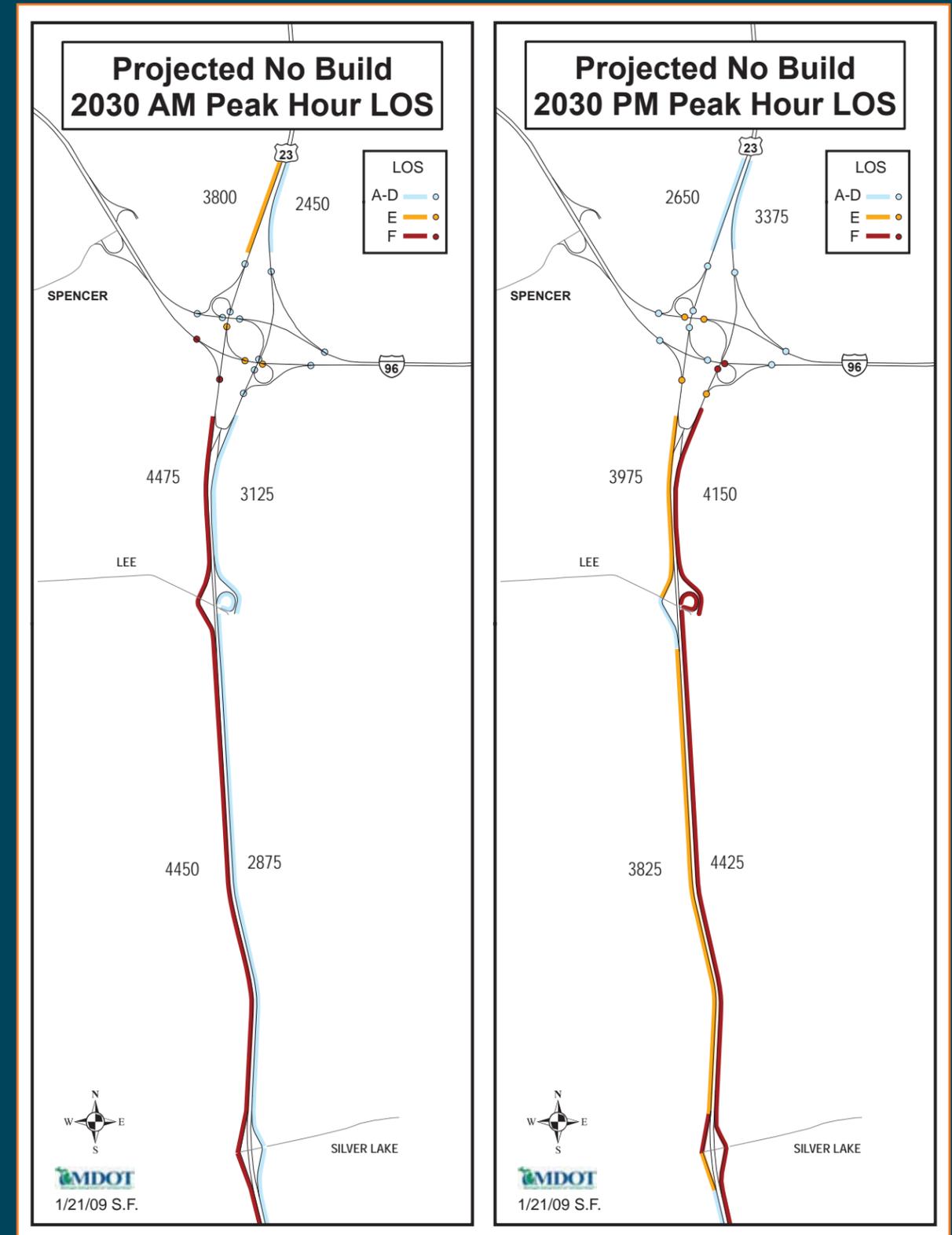
Future year (2030) peak-hour traffic projections for the North Segment were obtained from the SEMCOG Planning Model coupled with a review of historical growth. **Table 6-3** shows US-23 AM and PM Peak Hour data on basic freeway segments for 2030 Future Year under No-Build conditions. Southbound traffic in the entire North Segment operates at an unacceptable LOS during the 2030 AM Peak Hour. Southbound traffic between I-96 and Silver Lake and the northbound traffic in the entire North Segment operate at an unacceptable LOS during the 2030 PM Peak Hour. (**Figure 6-4: Projected No Build 2030 AM/PM Peak Hour LOS**).

TABLE 6-3

FUTURE (2030) AM & PM PEAK HOURS LEVEL OF SERVICE BASIC FREEWAY SEGMENTS ( NO-BUILD CONDITIONS)									
2030 Southbound US-23 AM Peak					2030 Southbound US-23 PM Peak				
Freeway Segment To/From	Volume, V	Flow Rate, Pc/hr	Density*, Pc/mi/ln	LOS	Volume, V	Flow Rate, Pc/hr	Density*, Pc/mi/ln	LOS	
N of I-96 to I-96 Interchange*	3,800	2,238	37.9	E	2,650	1,561	22.4	C	
I-96 Interchange to Lee Road	4,475	2,635	>45	F	3,975	2,341	42.1	E	
Lee Road to Silver Lake	4,450	2,621	>45	F	3,825	2,253	38.5	E	
Silver Lake to 9 Mile	4,650	2,738	>45	F	3,525	2,076	32.8	D	
2030 Northbound US-23 AM Peak					2030 Northbound US-23 PM Peak				
Freeway Segment To/From	Volume, V	Flow Rate, Pc/hr	Density*, Pc/mi/ln	LOS	Volume, V	Flow Rate, Pc/hr	Density*, Pc/mi/ln	LOS	
9 Mile to Silver Lake	2,400	1,413	20.2	C	4,625	2,753	>45	F	
Silver Lake to Lee Road	2,875	1,693	24.6	C	4,425	3,003	>45	F	
Lee Road to I-96 Interchange	3,125	1,840	27.3	D	4,150	2,989	>45	F	
I-96 Interchange to North of I-96	2,450	1,443	20.6	C	3,375	1,989	30.8	D	

\*Outside of project area

FIGURE 6-4



**2007 Ramp Merge/Weave Analyses (Existing Conditions)**

**Table 6-4** provides merge/weave traffic analyses along the mainline US-23 Corridor in the AM Peak Hour under existing conditions.

**TABLE 6-4**

EXISTING (2007) AM PEAK HOUR LEVEL OF SERVICE MERGE / WEAVE ANALYSIS									
2007 Southbound US-23 AM Peak									
	Fwy. Volume (vph)	Ramp Volume (vph)	Adj. Ramp Name	Adj. Ramp Volume	Freeway Flow Rate	Ramp Flow Rate	Adj. Ramp Flow	Density	Merge/Diverge LOS
Lee Road Off Ramp	3,225	475	Lee Road On Ramp	450	3,727	549	520	56.6	D
Lee Road On Ramp	2,750	450	Lee Road Off Ramp	475	3,178	520	549	29.1	D
Silver Road Off Ramp	3,200	250	Silver Road On Ramp	300	3,829	282	337	34.9	D
Silver Road On Ramp	2,950	300	Silver Road Off Ramp	250	3,474	338	282	33.5	D
2007 Northbound US-23 AM Peak									
Silver Road Off Ramp	2,000	100	Silver Road On Ramp	425	2,356	113	479	21.7	C
Silver Road On Ramp	1,900	425	Silver Road Off Ramp	100	2,238	479	113	24.5	C
Lee Road Off Ramp	2,325	375	Lee Road On Ramp	450	2,687	433	520	24.2	C
Lee Road On Ramp	1,950	450	Lee Road Off Ramp	375	2,253	520	433	23.1	C

**Table 6-5** provides merge/weave traffic analyses along the mainline US-23 Corridor in the PM Peak Hour under existing conditions. The analyses show the northbound Silver Lake and Lee Road off ramps to be operating at undesirable LOS.

**TABLE 6-5**

EXISTING (2007) PM PEAK HOUR LEVEL OF SERVICE MERGE / WEAVE ANALYSIS									
2007 Southbound US-23 PM Peak									
	Fwy. Volume (vph)	Ramp Volume (vph)	Adj. Ramp Name	Adj. Ramp Volume	Freeway Flow Rate	Ramp Flow Rate	Adj. Ramp Flow	Density	Merge/Diverge LOS
Lee Road Off Ramp	3,000	875	Lee Road On Ramp	700	3,467	1,011	809	31.8	D
Lee Road On Ramp	2,125	700	Lee Road Off Ramp	875	2,456	809	1,011	25.6	C
Silver Road Off Ramp	2,825	450	Silver Road On Ramp	175	3,328	508	197	30.6	D
Silver Road On Ramp	2,375	175	Silver Road Off Ramp	450	2,473	197	508	24.6	C
2007 Northbound US-23 PM Peak									
Silver Road Off Ramp	3,500	375	Silver Road On Ramp	325	4,123	423	367	36.9	E
Silver Road On Ramp	3,125	325	Silver Road Off Ramp	375	3,681	367	423	34.9	D
Lee Road Off Ramp	3,450	1,125	Lee Road On Ramp	875	3,987	1,300	1,011	35.4	E
Lee Road On Ramp	2,325	875	Lee Road Off Ramp	1,125	2,687	1,011	1,300	30.1	D

\*vph – volume per hour

**Table 6-6** summarizes ramp junction performance at the US-23/I-96 interchange during the AM and PM peak hours under existing (2007) conditions. Along I-96, three instances of ramps operating at unacceptable LOS were identified. In the AM peak hour, traffic from the eastbound I-96 ramp to northbound US-23 was found to currently operate at a LOS E. In the PM Peak period, the traffic from the northbound US-23 to the westbound I-96 on-ramp and the westbound I-96 off-ramp to southbound US-23 on-ramps operate at an unacceptable LOS.

TABLE 6-6

EXISTING (2007) AM AND PM PEAK HOUR LEVEL OF SERVICE US-23/I-96 INTERCHANGE RAMP JUNCTIONS									
US-23 Junctions		AM Peak Hour				PM Peak Hour			
		Fwy. Volume (vph)	Ramp Volume (vph)	Density	Merge/Diverge LOS	Fwy. Volume (vph)	Ramp Volume (vph)	Density	Merge/Diverge LOS
Mainline	Ramp								
NB US-23	To EB I-96	2400	675	20.4	C	3200	600	28.4	D
NB US-23	From EB I-96	1725	525	23.0	C	2600	350	29.4	D
NB US-23	To WB I-96	2250	900	19.4	B	2950	1500	26.4	C
NB US-23	From WB I-96	1350	575	18.8	B	1450	1200	25.0	C
SB US-23	To WB I-96	2975	475	19.3	B	2000	375	13.2	B
SB US-23	From WB I-96	2500	400	26.2	C	1625	875	22.3	C
SB US-23	To EB I-96	2900	1025	28.3	D	2500	625	24.3	C
SB US-23	From EB I-96	1875	1350	30.8	D	1875	1125	28.9	D
I-96 Junctions		AM Peak Hour				PM Peak Hour			
		Fwy. Volume (vph)	Ramp Volume (vph)	Density	Merge/Diverge LOS	Fwy. Volume (vph)	Ramp Volume (vph)	Density	Merge/Diverge LOS
Mainline	Ramp								
EB I-96	To SB US-23	4200	1350	30.1	D	3525	1125	26.1	C
EB I-96	From SB US-23	2850	1025	33.8	D	2400	625	23.9	C
EB I-96	To NB US-23	3875	525	39.2	E	3025	350	30.7	D
EB I-96	From NB US-23	3350	675	25.1	C	2675	600	21.1	C
WB I-96	To NB US-23	2400	575	18.3	B	3500	1200	26.1	C
WB I-96	From NB US-23	1825	900	22.7	C	2300	1500	36.2	E
WB I-96	To SB US-23	2725	400	26.4	C	3800	875	37.1	E
WB I-96	From SB US-23	2325	475	18.7	B	2925	375	21.0	C

\*vph – volume per hour

2030 Forecasted Ramp/Merge/Weave Analyses (No-Build Conditions)

Tables 6-7 and 6-8 summarize the anticipated performance of ramp junctions along US-23 under the future (2030) No-Build condition. As shown in Table 6-7, all southbound ramp junctions with Lee and Silver Lake Road are anticipated to operate at LOS F during the AM peak hour.

Table 6-8 shows during the PM peak, three of the four Lee Road and all of the Silver Lake ramp junctions are expected to perform at LOS E or F.

TABLE 6-7

FUTURE (2030) AM HOUR LEVEL OF SERVICE RAMP MERGE/WEAVE ANALYSES (NO-BUILD CONDITIONS)									
2030 Southbound US-23 AM Peak									
	Fwy. Volume (vph)	Ramp Volume (vph)	Adj. Ramp Name	Adj. Ramp Volume	Freeway Flow Rate	Ramp Flow Rate	Adj. Ramp Flow	Density	Merge/Diverge LOS
Lee Road Off Ramp	4,475	550	Lee Road On Ramp	525	5,171	636	1,156	46.5	F
Lee Road On Ramp	3,925	525	Lee Road Off Ramp	550	4,593	1,156	636	40.3	F
Silver Road Off Ramp	4,450	400	Silver Road On Ramp	600	5,242	451	677	47.1	F
Silver Road On Ramp	4,050	600	Silver Road Off Ramp	400	4,770	677	451	46.1	F
2030 Northbound US-23 AM Peak									
Silver Road Off Ramp	2,400	150	Silver Road On Ramp	625	2,827	169	705	25.8	C
Silver Road On Ramp	2,250	625	Silver Road Off Ramp	150	2,650	705	169	29.4	D
Lee Road Off Ramp	2,875	400	Lee Road On Ramp	650	3,322	462	751	29.7	D
Lee Road On Ramp	2,475	650	Lee Road Off Ramp	400	2,860	751	462	29.5	D

\*vph – volume per hour

TABLE 6-8

FUTURE (2030) PM HOUR LEVEL OF SERVICE RAMP MERGE/WEAVE ANALYSES (NO-BUILD CONDITIONS)									
2030 Southbound US-23 PM Peak									
	Fwy. Volume (vph)	Ramp Volume (vph)	Adj. Ramp Name	Adj. Ramp Volume	Freeway Flow Rate	Ramp Flow Rate	Adj. Ramp Flow	Density	Merge/Diverge LOS
Lee Road Off Ramp	3,925	1,000	Lee Road On Ramp	850	4,536	607	982	41.5	E
Lee Road On Ramp	2,925	850	Lee Road Off Ramp	1,000	3,438	982	607	34.5	D
Silver Road Off Ramp	3,825	650	Silver Road On Ramp	350	4,506	733	395	40.8	F
Silver Road On Ramp	3,175	350	Silver Road Off Ramp	650	3,739	395	733	36.0	E
2030 Northbound US-23 PM Peak									
Silver Road Off Ramp	4,625	675	Silver Road On Ramp	475	5,449	761	536	48.3	F
Silver Road On Ramp	3,950	475	Silver Road Off Ramp	675	4,652	536	761	43.8	F
Lee Road Off Ramp	4,425	1,275	Lee Road On Ramp	1,000	5,113	1,473	1,156	45.1	F
Lee Road On Ramp	3,150	1,000	Lee Road Off Ramp	1,275	3,640	1,156	1,473	38.6	E

\*vph – volume per hour

Table 6-9 summarizes ramp junction performance at the US-23/I-96 interchange during the AM and PM peak hours under the future (2030) No-Build condition. In the AM peak hour along US-23, all of the northbound junctions are expected to operate at acceptable levels of service. However, along southbound US-23, the ramps to and from eastbound I-96 are anticipated to operate at unacceptable LOS E or F. Along eastbound I-96, the ramp junctions between the southbound US-23 off-ramp to the northbound US-23 off-ramp are expected to operate at LOS E or F during the AM peak hour.

In the PM peak hour along US-23, four of the eight ramp junctions are expected to operate at unacceptable levels of service, including northbound US-23 at the ramps to and from eastbound I-96 and the ramp to westbound I-96, and at southbound US-23 at the ramp from eastbound I-96. The ramp junctions along westbound I-96 between the northbound US-23 on-ramp to the southbound US-23 off-ramp are expected to operate at LOS E.

TABLE 6-9

FUTURE (2030) NO-BUILD AM AND PM PEAK HOUR LEVEL OF SERVICE US-23 AND I-96 RAMP FREEWAY JUNCTIONS									
US-23 Junctions		AM Peak Hour				PM Peak Hour			
		Fwy. Volume (vph)	Ramp Volume (vph)	Density	Merge/Diverge LOS	Fwy. Volume (vph)	Ramp Volume (vph)	Density	Merge/Diverge LOS
Mainline	Ramp								
NB US-23	To EB I-96	3125	850	27.7	C	4150	775	37.8	E
NB US-23	From EB I-96	2275	650	29.0	D	3375	550	38.1	E
NB US-23	To WB I-96	2925	1200	26.1	C	3925	2100	36.1	F
NB US-23	From WB I-96	1725	725	23.4	C	1825	1550	31.3	D
SB US-23	To WB I-96	3800	650	24.2	C	2650	650	17.8	B
SB US-23	From WB I-96	3150	500	32.9	D	2000	1125	27.8	C
SB US-23	To EB I-96	3650	1275	35.7	E	3125	775	30.5	D
SB US-23	From EB I-96	2375	2100	41.7	F	2350	1625	37.5	E
I-96 Junctions		AM Peak Hour				PM Peak Hour			
		Fwy. Volume (vph)	Ramp Volume (vph)	Density	Merge/Diverge LOS	Fwy. Volume (vph)	Ramp Volume (vph)	Density	Merge/Diverge LOS
Mainline	Ramp								
EB I-96	To SB US-23	5825	2100	29.3	F	4300	1625	31.4	D
EB I-96	From SB US-23	3725	1275	46.4	E	2675	775	30.6	D
EB I-96	To NB US-23	5000	650	50.3	E	3450	550	34.9	D
EB I-96	From NB US-23	4350	850	31.3	D	2900	775	23.8	C
WB I-96	To NB US-23	2600	725	19.8	C	4325	1550	31.2	D
WB I-96	From NB US-23	1875	1200	26.4	C	2775	2100	47.3	E
WB I-96	To SB US-23	3075	500	29.9	D	4875	1125	47.7	E
WB I-96	From SB US-23	2575	650	21.5	C	3750	650	27.3	C

\*vph – volume per hour

**Figure 6-5: 2007 Operational Hotspots and Figure 6-6: 2030 Operational Hotspots** provides a summary of the primary traffic/operational concerns for each of the interchanges along the North Segment for 2007 Base Year and 2030 Future Year conditions. The 2007 Base Year and 2030 Future Year AM and PM Peak Hour traffic and Level of Service schematics for the each interchanges in the North Segment and I-96/US-23 are located at the end of this section. **(Figures 6-10 through 6-14)** These No-Build schematics include detailed turning movements at the interchange termini and analyses of selected adjacent roads' intersections.

**Safety**

**Table 6-10** provides crash data covering the North Segment between March 2005 and March 2008. Crashes total 640 and are broken down into nine categories as shown in the table. The most common crash type is the Rear-End Straight totaling 335 crashes, 52 percent of the total. Just under 60 percent of the crashes took place during the hours of darkness, and in icy or wet conditions. There were three fatalities and 147 injuries during this three-year period.

**TABLE 6-10**

US-23 CRASH TYPES NORTH SEGMENT 3/2005-3/2008	
Crash Type	Count
Misc. 1 Vehicle	45
Overturn	16
Fixed Object	90
Other Object	17
Animal	44
Angle Straight	13
Rear-End Straight	335
Side Swipe Same	68
Other	9
<b>Total</b>	<b>640</b>

**Figure 6-7: Crashes North Segment** distinguishes the incapacitating injuries and fatalities from the remaining crashes by location in the north segment. **Figure 6-8: Crash Patterns and Planned Improvements** provides crash patterns and planned improvements along the north segment.

**Mobility**

Under existing conditions, there is no fixed-route transit service offered along this segment of the US-23 corridor, or on nearby collector roadways. Livingston Essential Transportation Service (LETS) does offer demand-responsive para-transit services in the vicinity, although these services do not play a significant role in supporting travel along the corridor itself.

MDOT operates and maintains four carpool lots along or within the vicinity of the North Segment: one is located at the US-23/Silver Lake Road interchange, one at the US-23/Lee Road interchange, and two located at the I-96/Spencer Road interchange. The Silver Lake Road lot is a gravel surface with 50 parking spaces. At Lee Road, a new paved lot was recently constructed as part of an interchange improvement project, which includes 144 spaces.

**POTENTIAL ENVIRONMENTAL IMPACTS AND ASSOCIATED CONSTRAINTS**

The potential environmental constraints within the North Segment of the project study area include 4(f) and 6(f) concerns at the Island Lake Recreation Area; this is only a concern if additional ROW is required. There are numerous wetlands located in this segment of the study area. A Part 303 permit from the Michigan Department of Environmental Quality (MDEQ) will be required, as well as, wetland mitigation if there is any loss of wetland area. Additionally, there may be "no work" dates during the breeding season from March 1st through May 31st for any work within the Huron River or Horseshoe Lake Drain. **Figure 6-9: Constraints Map** shows the Constraints Map for the North Segment.



FIGURE 6-5

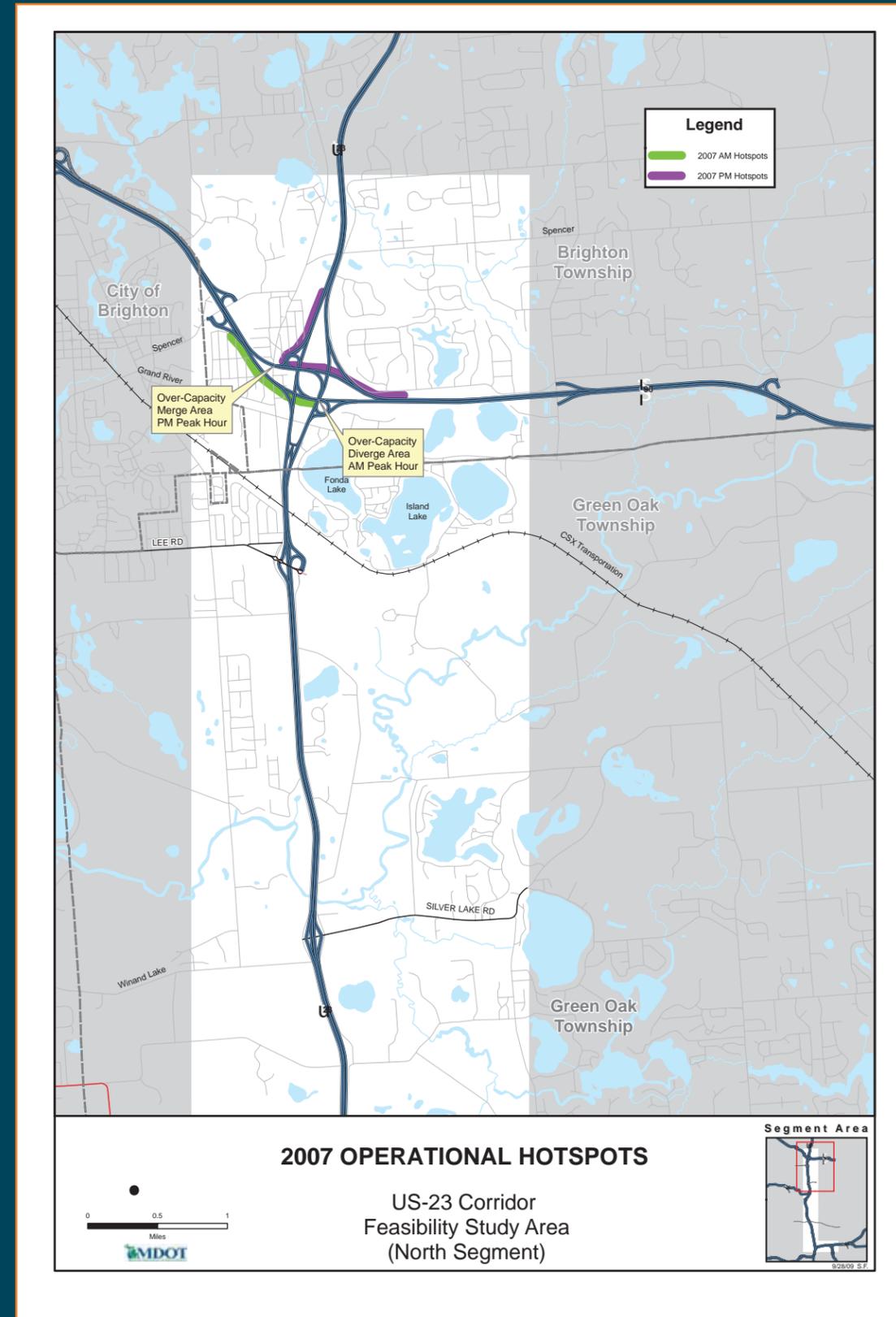


FIGURE 6-6

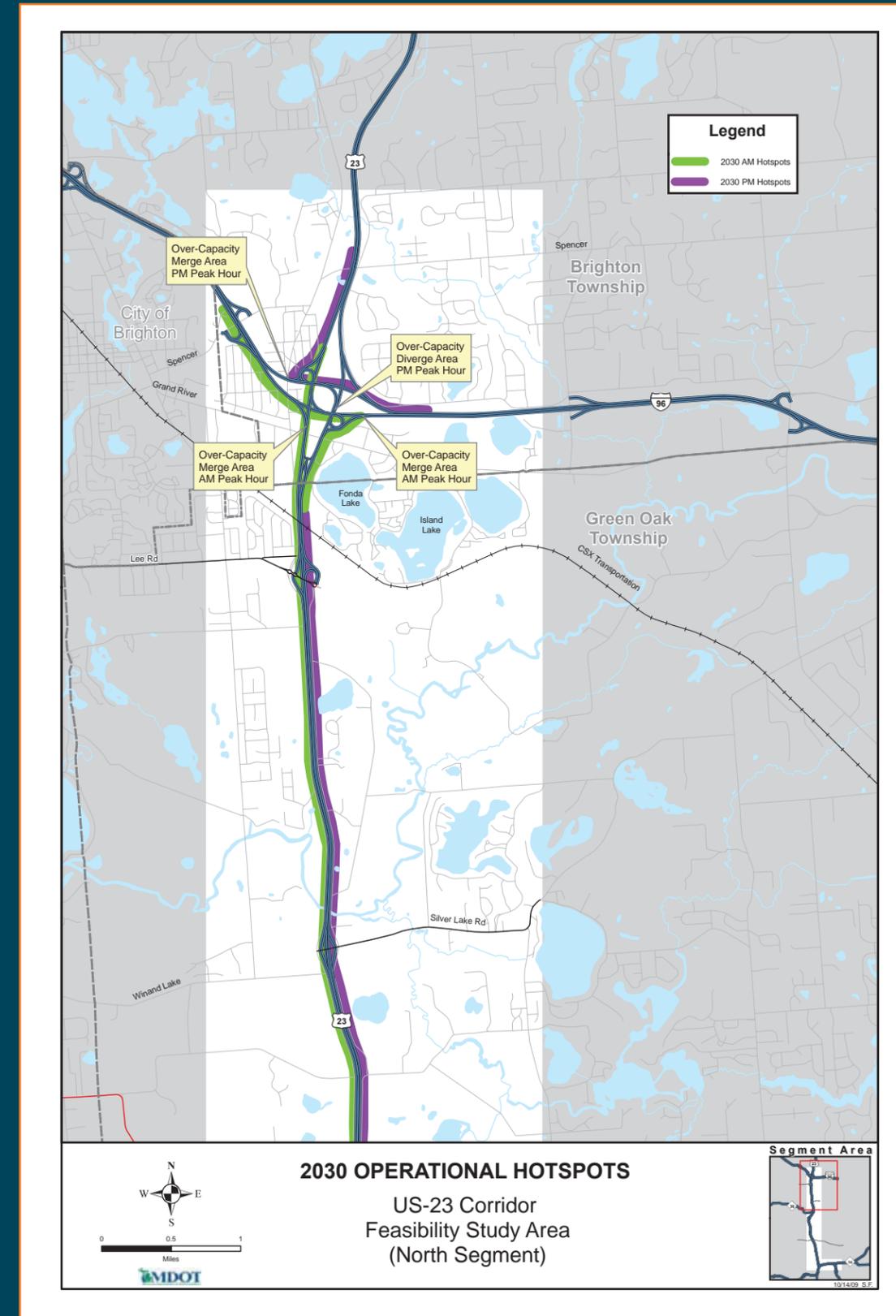


FIGURE 6-7

## US-23 Crashes - North Segment

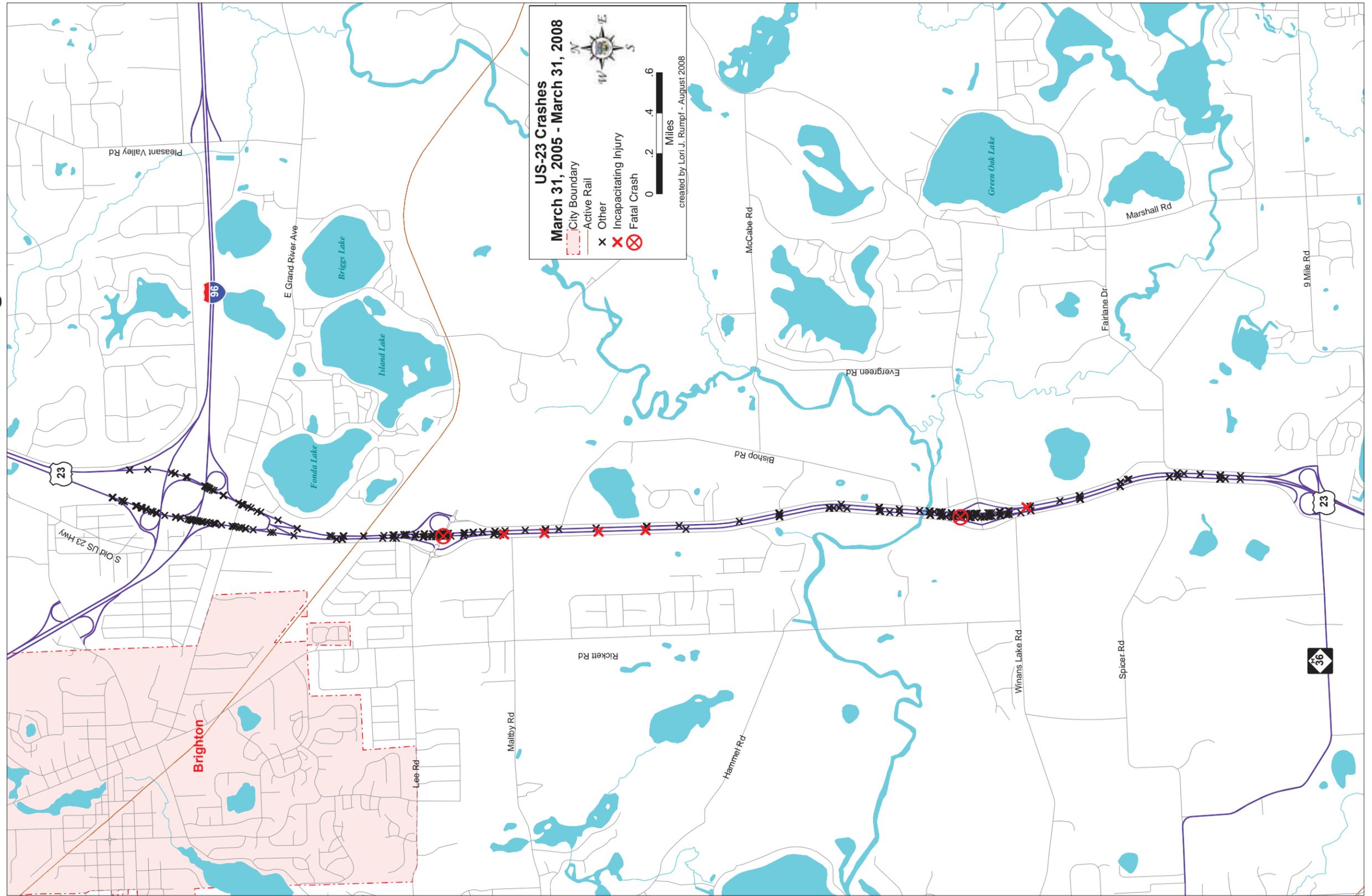


FIGURE 6-8

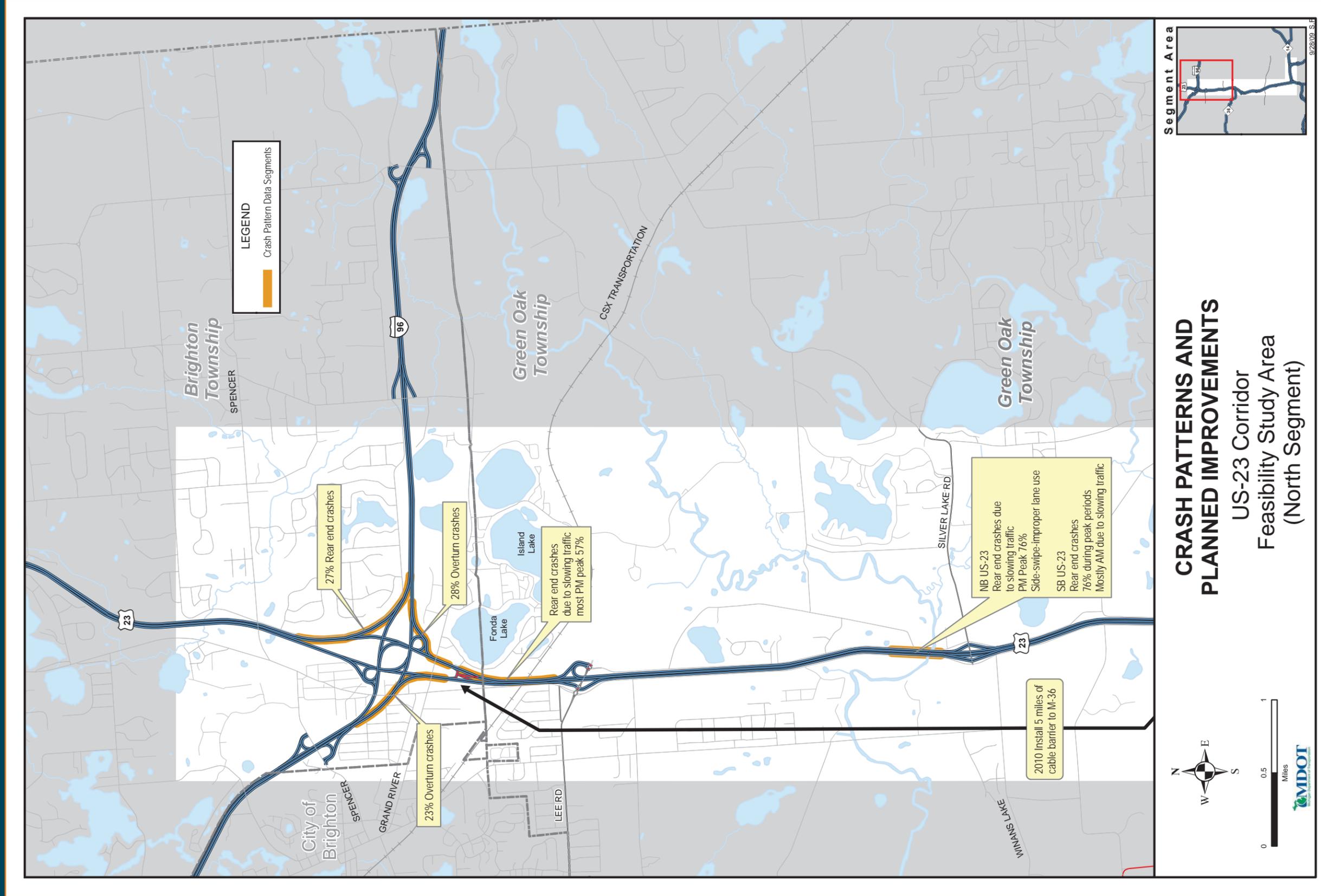


FIGURE 6-9

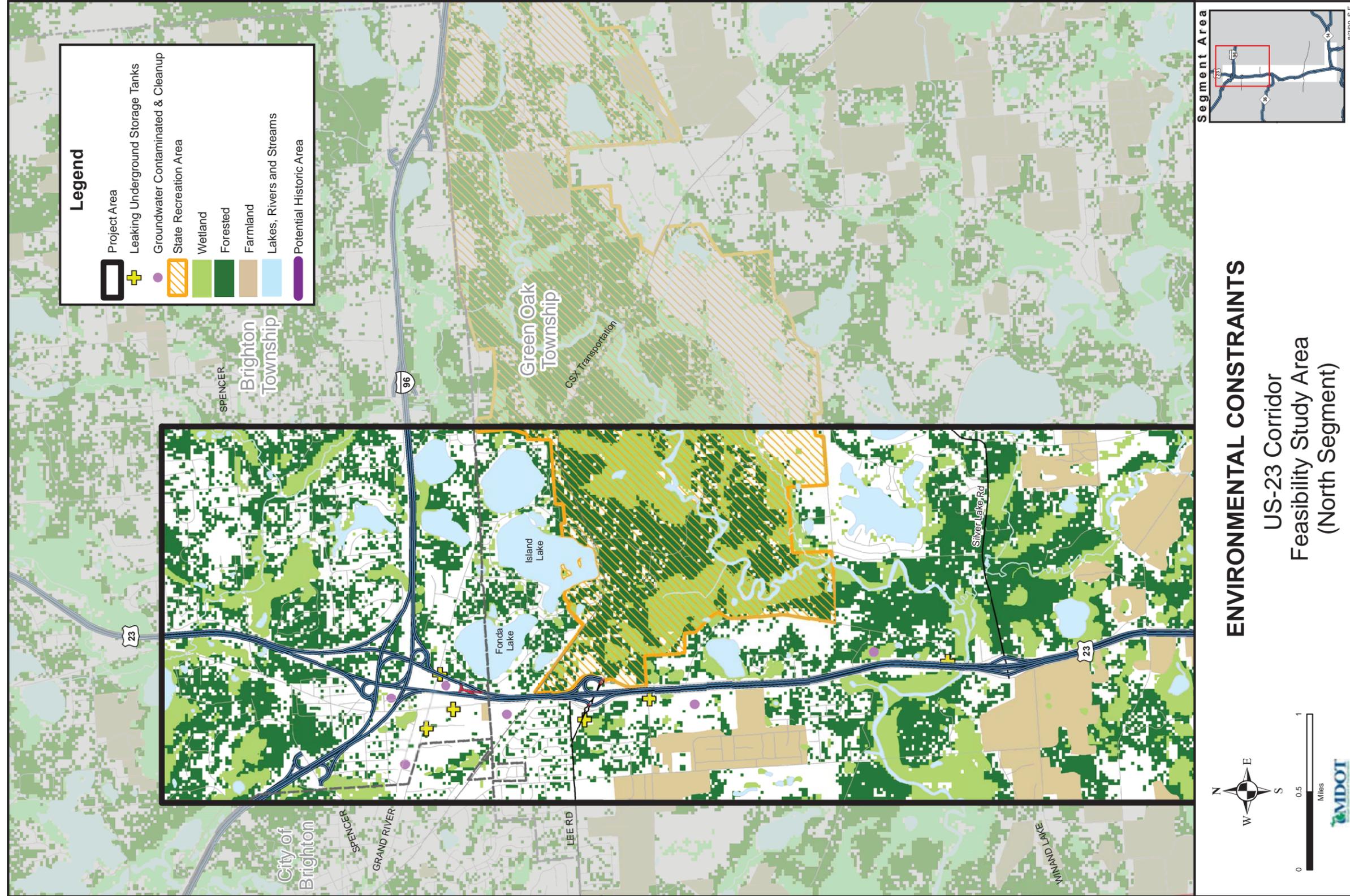
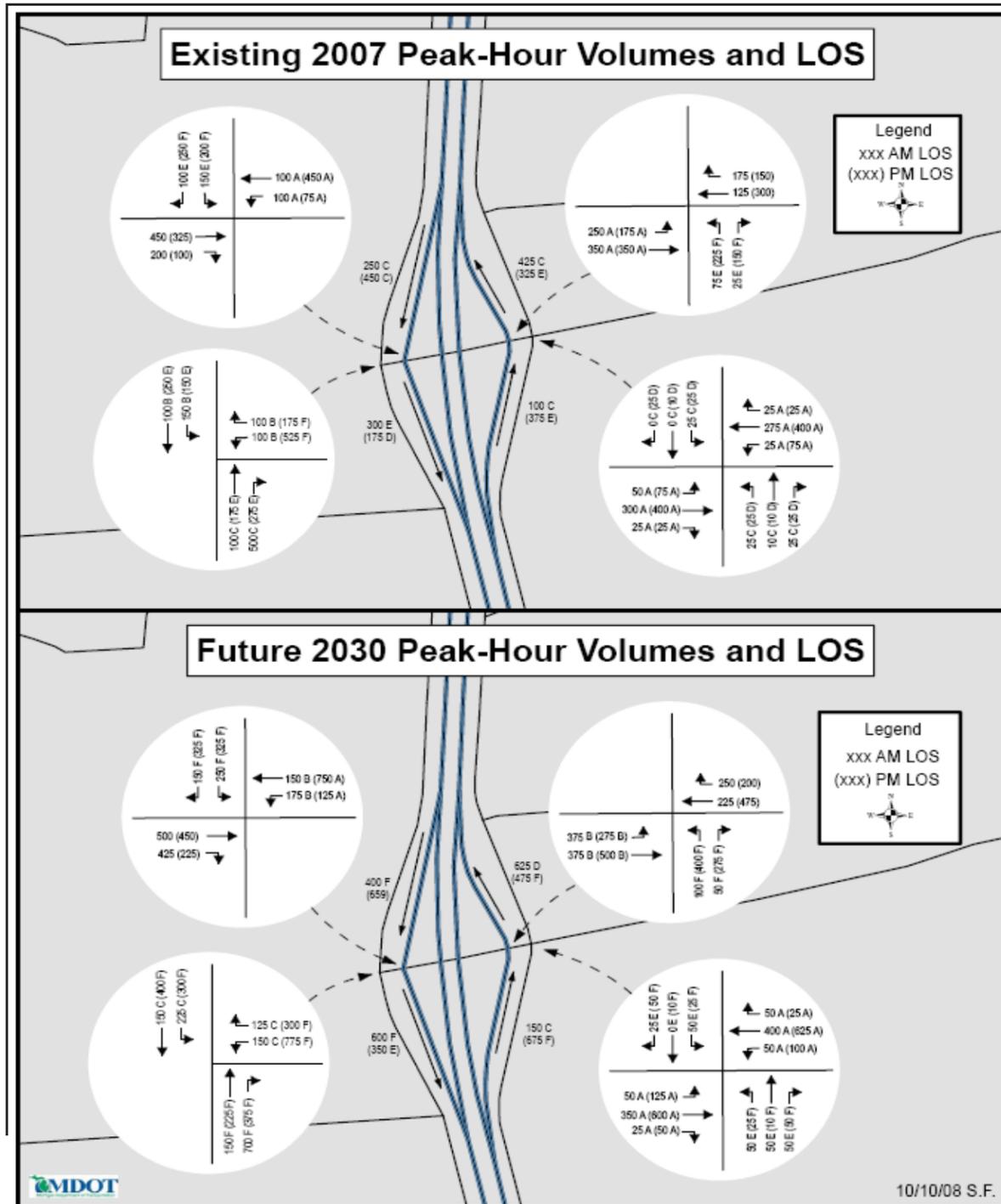


FIGURE 6-10

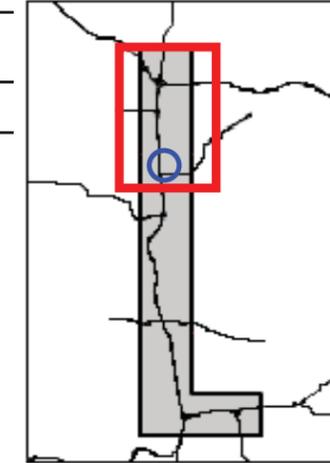


**Issues and Constraints**

- 1 Short merge/taper lengths on entrance/exit ramps
- 2 Ramps and local service road intersections are too close.
- 3 Tight right-of-way to accommodate widening bridges.



**Project Area**



- 4 Structures in poor to fair condition.



FIGURE 6-11



**LEGEND**

EX. PARCEL LINES	EX. BRIDGE STRUCTURE
EX. RIGHT OF WAY	
EX. LIMITED ACCESS RIGHT OF WAY	

NORTH

0 100' 200'

SCALE: 1" = 200'

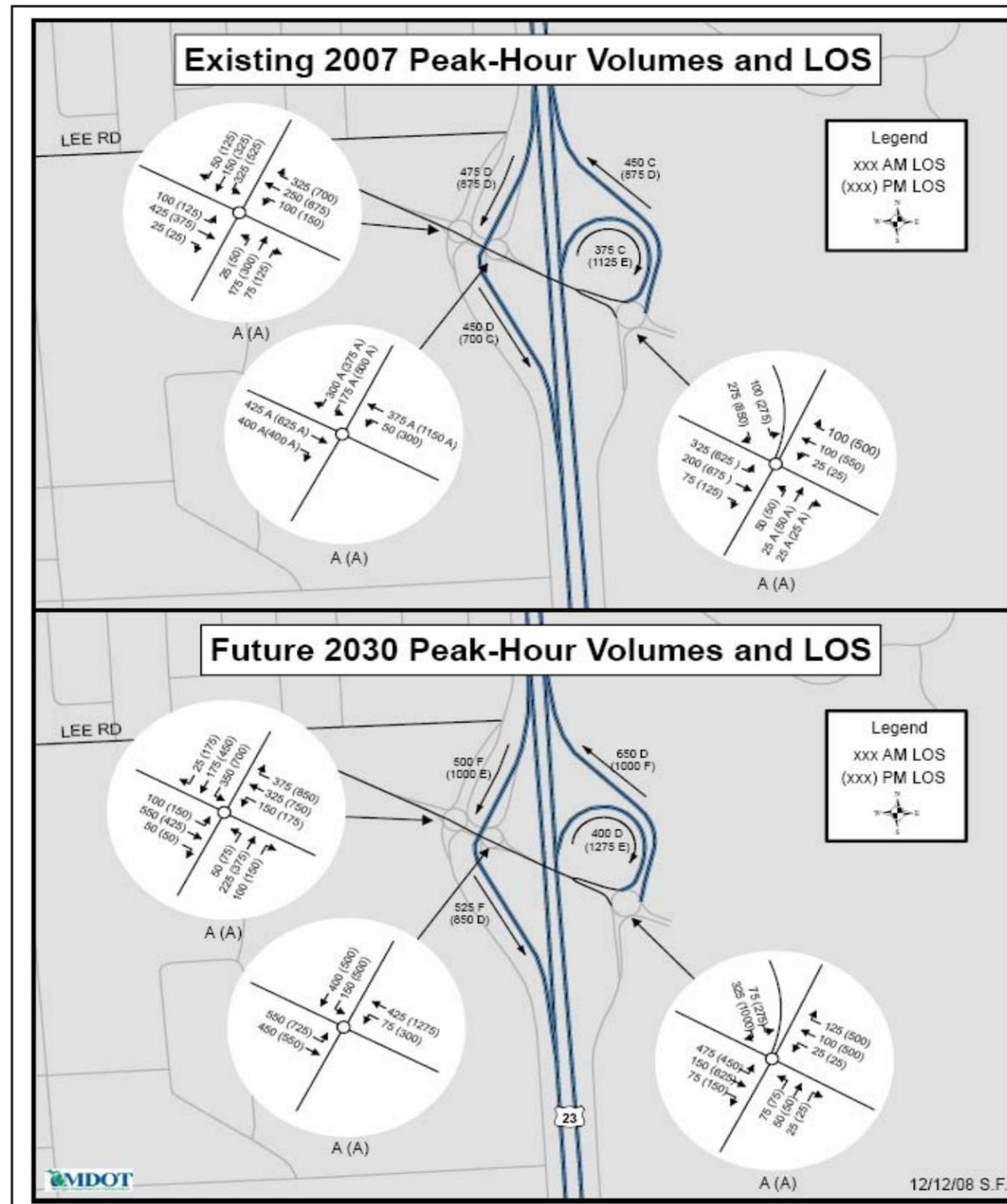


EXISTING US-23/SILVER LAKE ROAD INTERCHANGE

DATE	CONT. SEC.	JOB NO.	DESIGN UNIT	SHEET NO.
09/17/08	47013	101993	HULLEY	R.O.W CONST.

DATE: 09/17/08  
 WORKED ON BY: M. Sanchez  
 DATE:  
 CHECKED BY:  
 FILE NAME: Silver Lake-Ex.dgn

FIGURE 6-12

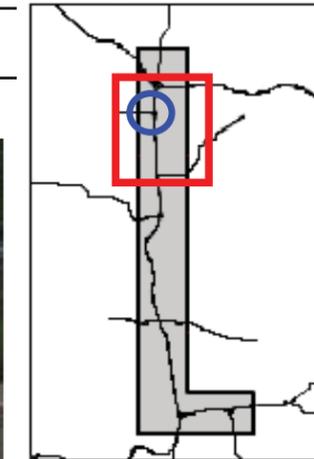


Issues and Constraints

- 1 Tight entrance/exit ramp radii
- 2 Short merge/taper lengths on entrance/exit ramps



Project Area



- 3 Structure in poor condition.



FIGURE 6-13

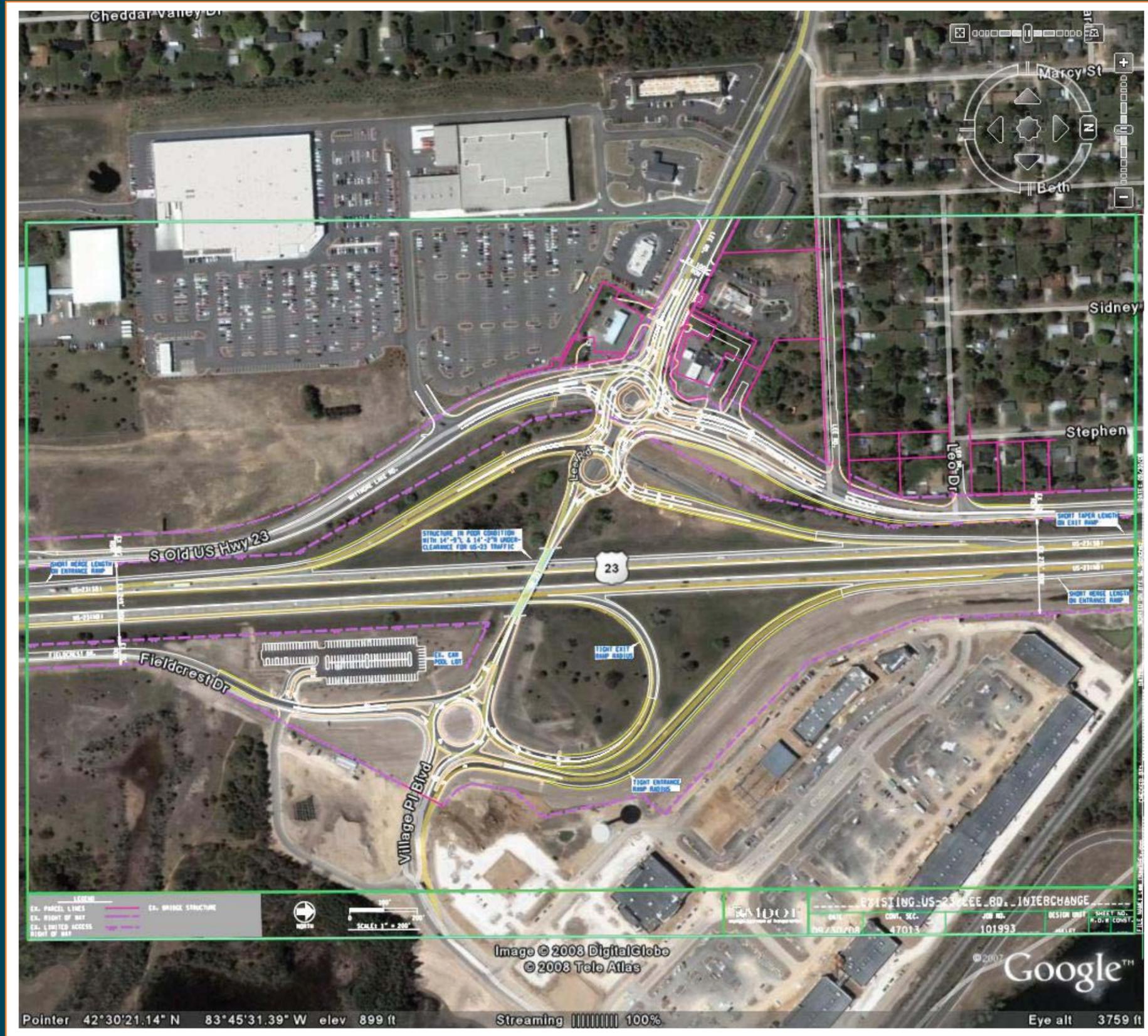
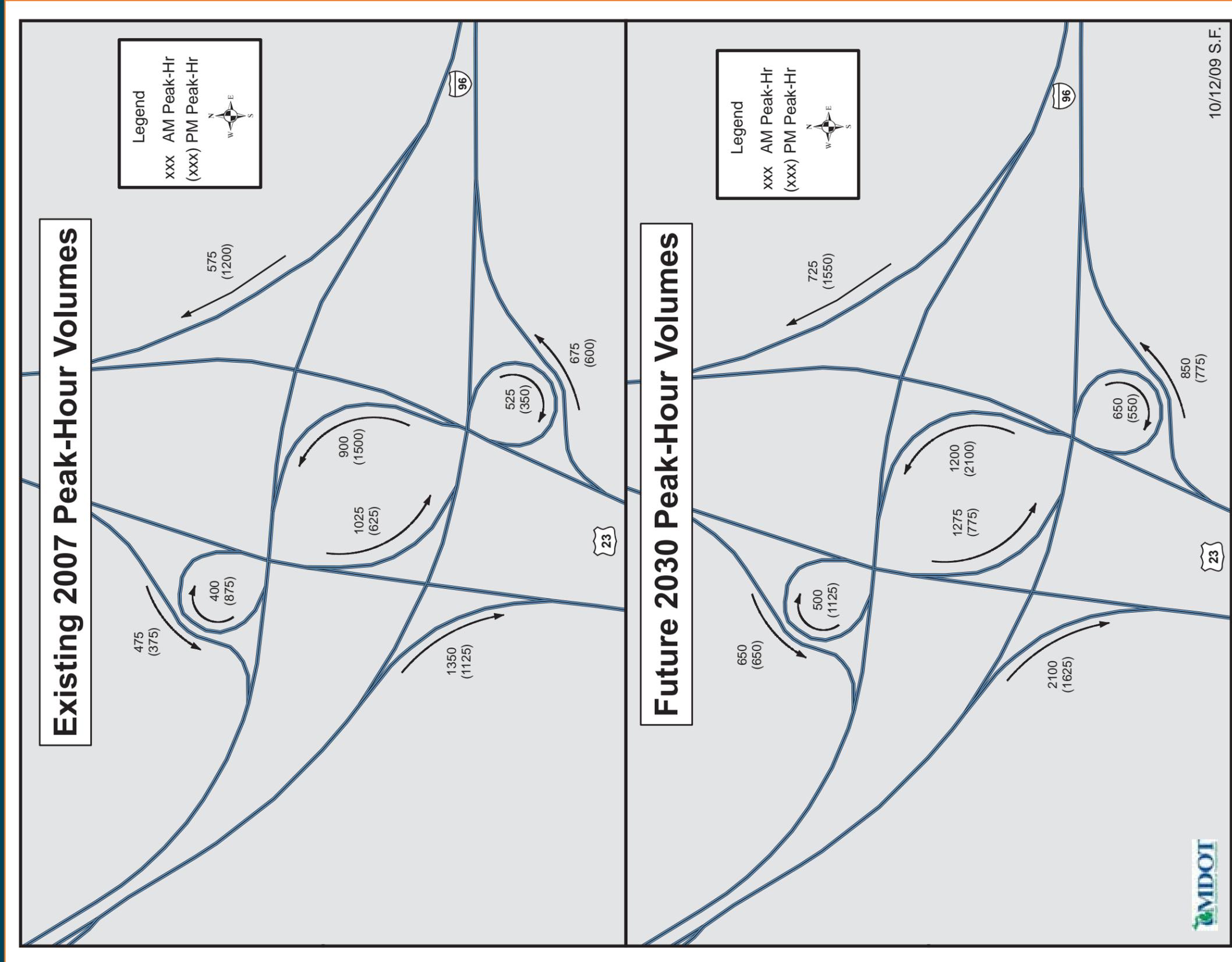


FIGURE 6-14





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