Appendix 6.6

BRENT SPENCE BRIDGE CORRIDOR

Moving the Economy,
Creating Jobs

BRENT SPENCE BRIDGE PROJECT

TRANSMODELER CALIBRATION AND RESULTS

MAY 2020

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

KENTUCKY TRANSPORTATION CABINET

HNTB

1. PROJECT BACKGROUND AND PURPOSE

1.1 BACKGROUND

In March 2012, an Environmental Assessment was prepared for the Brent Spence Bridge (BSB) project to analyze impacts to the natural and human environment for two feasible alternatives for improving the I-71/I-75 Corridor in Kentucky and Ohio. In August 2012, the Federal Highway Administration (FHWA) issued a Finding of No Significant Impact (FONSI) identifying the selected alternative for the BSB project. This selected alternative is referred to as Alternative I.

Two primary studies were conducted since 2013. The *Brent Spence Bridge Corridor Study (BSBC Study)* in 2013-2015 evaluated the impacts of tolls on the Brent Spence Bridge and completed traffic tasks including data collection, forecasting, travel demand modeling, and traffic operational analysis using HCS and VISSIM. In addition to the toll evaluation, alternative designs were evaluated including Concept W (also known as Whiz Bang).

The *Brent Spence Strategic Corridor Study (Strategic Corridor Study)* in 2017 included the development and evaluation of Brent Spence Bridge bypass concepts and corridor operations using TransModeler. The project's operational analysis evaluated the impacts of an Eastern Bypass on the operations of the Brent Spence Bridge and completed data collection for use in the model calibration. The traffic projections used model assignments from the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) travel demand model.

Both the *BSBC Study* and the *Strategic Corridor Study* obtained traffic counts and used the OKI travel demand model to forecast traffic in 2040. Since May 2019, OKI has set up continuous traffic counters on the BSB and other nearby bridges over the Ohio River.

In December 2019, a review of the traffic modeling and forecasts was finalized with data from these earlier BSB studies, titled *Traffic Counts, Modeling, and Forecast Review*. In this study, the 2040 regional travel model from OKI was utilized to project future traffic volumes. The BSB traffic projections include proposed improvements to the bridge and I-71/I-75 corridor in Kentucky and Ohio based on the current selected Alternative I and assumed no tolling.

Based on these efforts, KYTC and ODOT established the following criteria for the BSB project:

- The baseline traffic volume 160,000 VPD will be used for any additional near-term studies.
- The 2040 Toll Free estimated traffic volume of 227,900 VPD will be used in any near-term design and traffic studies.
- OKI is developing an updated regional travel demand model for year 2050 with current travel and census data. This model will be incorporated into the traffic forecasts for the BSB project when complete, and the forecasts will be extended to 2050.

Also in December 2019, a performance-based design workshop was held with members of ODOT, KYTC, FHWA and HNTB in attendance. The goal of the workshop was to identify concepts that could reduce the construction cost of selected Alternative I for the BSB corridor. The performance-based design workshop identified three new concepts for the BSB project for further traffic operational and design study. These concepts and the results of the additional study are discussed in the following sections.

1.2 PURPOSE

The purpose of this report is to continue the evaluation of the corridor concepts identified in the BSB performance-based design workshop. Microsimulation using TransModeler was selected as the traffic analysis tool for this project due to the complexity of the I-71/I-75 system interchange. Transmodeler calibration was updated for this project, using the 2017 *Strategic Corridor Study* models as a base, with some additions to the model network and traffic count targets. The Build alternatives are analyzed using 2040 traffic volumes developed for Alt I and Concept W during the *BSBC study*.

This report describes the model calibration methodology, validation results, and operational results for the concepts, developed in coordination with the geometric design efforts. The traffic analysis completed for this project is preliminary and is used to identify the feasibility of each concept. Further analysis will be completed as part of future projects with updated base traffic data for model calibration and forecasts for the scenario analysis. It was recognized that a more comprehensive calibrated model will be required for analysis to support the project NEPA document and Interstate Access Request (IAR).

2. MODEL SCENARIOS

<u>2017 Existing</u>

Existing conditions for the I-71/I-75 corridor between the I-275 interchange in Kentucky and Western Hills Viaduct in Ohio.

<u>2040 Concept W</u>

Build configuration for the Brent Spence Bridge with local access traffic on the existing bridge, and interstate through traffic on the new bridge.

<u>2040 Concept M</u>

Build configuration for the Brent Spence Bridge with I-71 traffic on the existing bridge, and I-75 traffic on new bridge. Some local access traffic is present on both bridges, with many existing connections maintained on the existing bridge.

<u>2040 Concept WS</u>

Build configuration for the Brent Spence Bridge following Concept W in Ohio with a superstreet configuration on the local CD road in Kentucky.

3. METHODOLOGY

The TransModeler models are developed following guidelines from the DRAFT *ODOT Analysis and Traffic Simulation Manual: Traffic Simulation with TransModeler.* The model development has the following steps:

1) Existing Model Network Development:
    a. The corridor model developed in 2017 for the *Strategic Corridor Study* is used as the starting model.
    b. Small network adjustments were made to capture the needs of the scenario modeling.
2) Volume Development
    a. Traffic volumes used for the 2017 *Strategic Corridor Study* were reviewed and used as the target volume set for calibration.
    b. 2017 *Strategic Corridor Study* volumes were supplemented with counts collected by ODOT Traffic Monitoring Management System (TMMS).
    c. Model periods are established as 6:00-10:00 AM and 2:00-7:00 PM.
    d. Existing origin-destination (OD) matrices were synthesized using TransModeler ODME tools and set the previous model OD as a seed matrix and 2017 traffic counts as target volumes.
    e. Build Scenario OD's were developed using peak design hour forecasts from the 2015 *BSBC Study*.
3) Existing Model Calibration
    a. Volume convergence checks for the peak period volumes
        i. 85% of peak period volumes are within 15% of the counts
        ii. Model/count regression line is close to 1 (not less than 0.95 and not greater than 1.05)
        iii. Model/Count regression line intercept is close to 0, an absolute value less than 10
    b. Speed and Bottleneck review
        i. Observed speed heat maps from INRIX data are compared to delay trends from the models
    c. Point-to-point travel times for I-71/I-75 are compared between field observed (INRIX) and model results
4) Scenario Modeling
    a. MOE's for Freeway segments include:
        i. Travel Speeds
        ii. Freeway Level of Service
        iii. Visual Network audit, including vehicle queue identification

4. VOLUME DEVELOPMENT

4.1 2017 EXISTING

Existing models represent a year 2017 condition. The project team started from previously developed models and traffic counts taken during the *Strategic Corridor Study* in 2017. This study existing model defined the AM period as 6:00-10:00 AM and PM period as 2:00-6 :00PM.

Updates to the existing model volume were made using TransModeler's built-in ODME tool to refine the model origin-destination matrices to account for a few updates, including:

- Model network adjusted at the following locations:
  - Added origin node 28 at 4th Street entrance ramp to I-75 northbound
  - Added origin node 36 at 6th Street entrance ramp to I-75 northbound
  - Separated origin node 105 at I-71 westbound into two separate nodes
  - Separated destination node 158 at I-71 westbound into two separate nodes
  - Separated node 189 at Priority Road into separate origin and destination nodes
- Extended PM period to 2-7 PM to capture entire PM peak period traffic
- Removed traffic count targets based on network balancing review

4.2 2040 BUILD

During the 2015 *BSBC Study*, certified design hour traffic volumes were developed for Concept W. Using these forecasts, origin-destination (OD) matrices were synthesized for the AM and PM design hours. Peak hour origin-destination matrices were synthesized using a simple seed matrix that eliminates illogical paths. The OD matrices were estimated to match the peak design hour forecasts assuming one logical path between each origin and destination, which is consistent with the linear study corridor. The synthesized OD matrices for Concept W were used for the other build scenarios.

The peak hour build OD matrices were expanded to period matrices using factors of 2.6 (AM) and 3.1 (PM). These factors were derived from Brent Spence Bridge counts. The 15-minute loading of the period matrices follow existing profiles.

5. EXISTING MODEL CALIBRATION

Microsimulation was selected as the traffic analysis tool for project scoping due to the complexity of the I-71/I-75 system interchange and local service ramps along the I-75 corridor. The model developed for the *Strategic Corridor Study* was updated with available traffic counts from various sources and dates. The model was calibrated appropriately for project scoping, but a more comprehensive calibrated model will be required for analysis to support the project NEPA document and Interstate Access Request (IAR). The procedures for data collection and calibration are outlined in the *FHWA Analysis Tools Volume III*.

5.1 TRAFFIC VOLUME

The validated 2017 model volumes were compared against traffic counts along the I-71/I-75 freeway mainline and ramps between Buttermilk Pike on the south and Western Hills Viaduct on the north. Validation criteria was not compared for areas south of the Buttermilk Pike, as it is outside the study limits. A plot of the AM and PM model volumes against traffic counts are shown in **Figure 1** (AM) and **Figure 2** (PM).

The existing models meet DRAFT ODOT modeling guidance for volume validation by having 90% of AM peak and 96% of PM peak traffic counts within 15% of model volumes. Additionally, the regression line in the model/count plot is 1.019 (AM) and 1.004 (PM). This outcome is within the acceptable range of 0.95 to 1.05. The Y-intercept is -118 (AM) and -43 (PM) which is just outside the desirable range of +- 10.

Table 1 and **Table 2** show convergence of the model volumes to traffic counts for I-71/I-75 southbound and northbound. The modeled volumes were within 15% of the counts, more than 85% of the time.

Volume profiles were created based on traffic counts and adjusted to replicate speeds and bottlenecks. The volume profiles for the AM and PM peak periods are summarized in **Figure 3** and **Figure 4**. These profiles are used globally for the project area and applied consistently for Existing and Future Build scenarios.

The vehicle mix was determined by aggregating traffic counts throughout the study area. Rather than creating a separate ODME matrix for cars, single unit trucks, and trailer trucks, the vehicle mix was applied consistently to all OD pairs. The fleet has 3% single unit trucks and 5% trailer trucks, 20% pick-up truck or SUV, and the remaining 72% are passenger vehicles ranging from high performance to low performance.

Figure 1: Comparison of AM Period Model Assignments Versus Counts

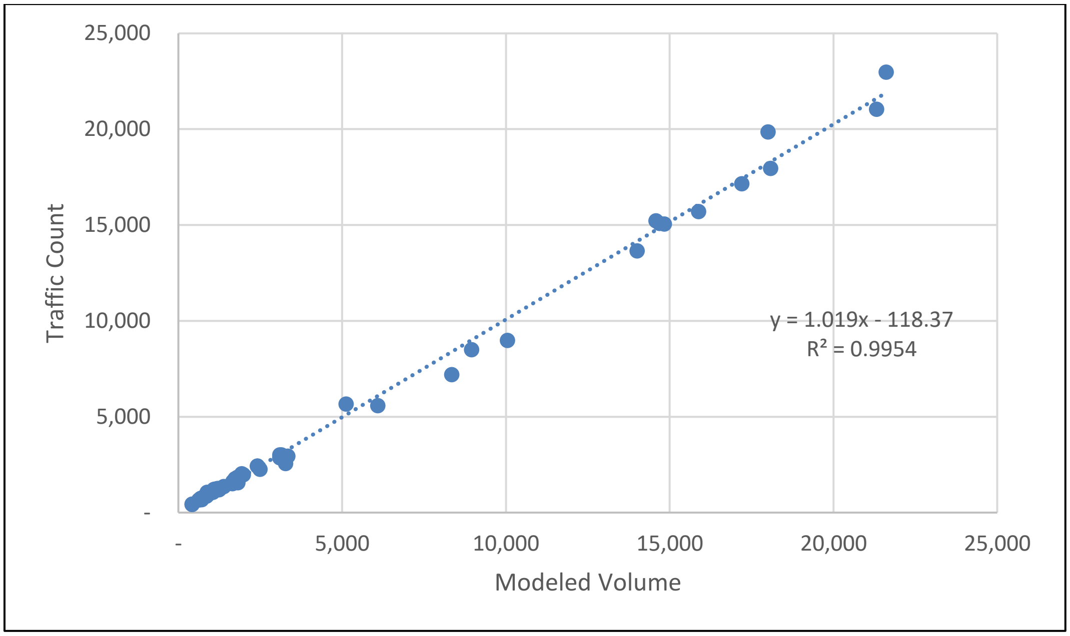


Figure 2: Comparison of PM Period Model Assignments Versus Counts

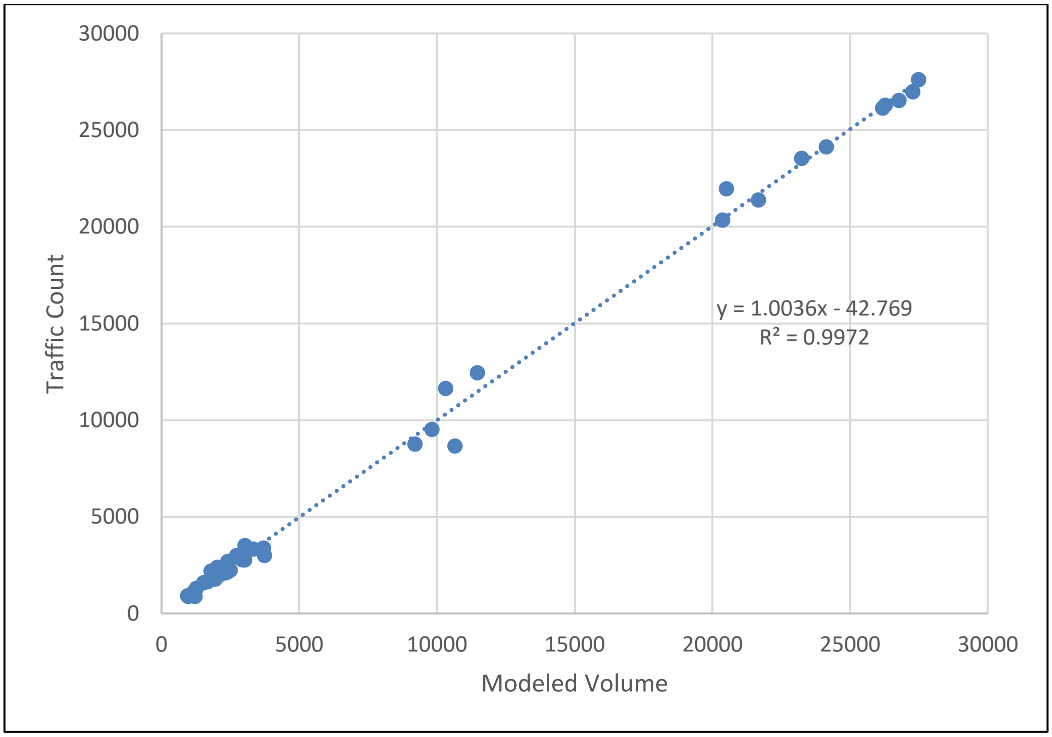


Table 1: SB I-71/I-75 Volume Validation

Location	AM Peak			PM Peak		
	Count	Modeled Volume	Percent Difference	Count	Modeled Volume	Percent Difference
SB Mainline north of Western Hills Viaduct	21,319	21,044	1.3%	24,143	24,880	3.1%
SB Exit Ramp to Western Hills Viaduct	1,026	1,067	4.0%	3,020	2,880	4.6%
SB Entrance Ramp from Western Hills Viaduct	3,100	3,013	2.8%	2,403	2,613	8.7%
SB Mainline between Western Hills Viaduct and Findlay	21,620	22,972	6.3%	23,245	24,595	5.8%
SB Exit Ramp to Western near Findlay	1,814	1,836	1.2%	2,128	2,098	1.4%
SB Exit Ramp to Western near Ezzard Charles	1,242	1,200	3.4%	973	882	9.4%
SB Mainline between Ezzard Charles and Freeman	-	19,947	-	-	21,616	-
SB Exit Ramp to Freeman	1,666	1,616	3.0%	1,956	1,826	6.6%
SB Entrance Ramp from Western near Gest	761	794	4.3%	1,533	1,667	8.7%
SB Exit Ramp to 7th	3,147	3,011	4.3%	954	876	8.2%
SB Split to I-71 EB, 5th and 2nd	8,958	8,498	5.1%	9,817	10,155	3.4%
SB Exit Ramp to 5th	1,985	1,983	0.1%	2,499	2,233	10.6%
SB Mainline between 7th and 9th	-	16,114	-	-	20,589	-
SB Entrance Ramp from 9th	425	431	1.4%	1,799	3,331	85.2%
SB Entrance Ramp from EB US 50/6th St Expy	1,707	1,605	6.0%	2,330	2,524	8.3%
SB Entrance Ramp from SB I-71/WB US 50	6,094	5,580	8.4%	11,467	11,410	0.5%
SB Mainline on Brent Spence Bridge	14,583	15,228	4.4%	26,285	27,699	5.4%
SB Exit Ramp to 5th in KY	1,824	1,555	14.7%	2,931	3,090	5.4%
SB Exit Ramp to Pike and 12th	1,129	1,231	9.0%	2,408	2,538	5.4%
SB Mainline at 5th in KY	-	13,678	-	-	24,628	-
SB Entrance Ramp from 4th	1,391	1,357	2.4%	3,744	4,071	8.7%
SB Entrance Ramp from 12th	1,211	1,258	3.9%	2,402	2,583	7.5%
SB Mainline south of 12th	14,839	15,052	1.4%	27,276	28,707	5.2%
SB Exit Ramp to Kyles Ln	1,652	1,514	8.4%	2,910	2,931	0.7%
SB Entrance Ramp from Kyles Ln	1,092	1,201	10.0%	1,979	2,269	14.7%
SB Mainline south of Kyles Ln	-	14,729	-	-	28,016	-
SB Exit Ramp to Dixie Hwy	715	682	4.6%	2,365	2,330	1.5%
SB Entrance Ramp from Dixie Hwy	881	1,062	20.5%	2,028	2,264	11.6%
SB Mainline south of Dixie Hwy	14,692	15,080	2.6%	26,183	27,709	5.8%

Table 2: NB I-71/I-75 Volume Validation

Location	AM Peak			PM Peak		
	Count	Modeled Volume	Percent Difference	Count	Modeled Volume	Percent Difference
NB Mainline north of Western Hills Viaduct	18,091	17,958	0.7%	27,489	27,855	1.3%
NB Entrance Ramp from Western Hills Viaduct	2,419	2,425	0.2%	2,144	2,052	4.3%
NB Entrance Ramp from Winchell near Bank	1,059	1,063	0.4%	2,368	2,241	5.4%
NB Entrance Ramp at Western Hills Viaduct	2,419	2,425	0.2%	2,144	2,052	4.3%
NB Exit Ramp to Western Hills Viaduct	1,269	1,218	4.0%	3,331	3,576	7.4%
NB Mainline between Ezzard Charles and Western Hills	15,890	15,703	1.2%	26,777	27,164	1.4%
NB Entrance Ramp from Winchell at Ezzard Charles	423	441	4.3%	1,215	1,161	4.4%
NB Mainline north of Ezzard Charles	-	15,284	-	-	26,033	-
NB Entrance ramp from Gest/Freeman	1,750	1,772	1.3%	2,363	2,287	3.2%
NB Entrance Ramp from Winchell/9th	633	665	5.1%	2,728	2,713	0.5%
NB Entrance Ramp from Freeman	1,750	1,772	1.3%	2,363	2,287	3.2%
NB CD (I-71 SB/US 50 WB, 4th and 6th) ramp to Winchell	-	1,461	-	-	3,012	-
NB Entrance Ramp from CD (I-71 SB/US 50 WB, 4th and 6th Street)	5,127	5,657	10.3%	10,318	11,333	9.8%
NB Mainline between 6th and 7th	8,347	7,197	13.8%	10,654	9,708	8.9%
NB Exit Ramp to WB US 50/6th St Expy	1,941	2,024	4.3%	3,028	3,236	6.9%
NB Exit Ramp to 5th in Ohio	1,683	1,641	2.5%	1,109	1,146	3.3%
NB Exit Ramp to NB I-71/EB US 50	10,052	8,983	10.6%	9,208	8,895	3.4%
NB Mainline on Brent Spence Bridge	18,012	19,866	10.3%	20,509	23,016	12.2%
NB Entrance from 5th St in KY	3,350	2,949	12.0%	3,710	3,761	1.4%
NB Exit Ramp to 12th St	3,274	2,563	21.7%	1,667	1,797	7.8%
NB Mainline south of 5th Street	-	16,952	-	-	19,299	-
NB Exit Ramp to 5th St in KY	1,733	1,754	1.2%	2,005	2,134	6.4%
NB Entrance Ramp from 12th St	924	962	4.1%	2,157	2,413	11.9%
NB Mainline South of 12th St	17,208	17,157	0.3%	21,674	22,126	2.1%
NB Entrance Ramp from Kyles Ln	3,098	2,855	7.8%	2,220	2,315	4.3%
NB Exit Ramp from Kyles Ln	690	739	7.1%	2,171	2,342	7.9%
NB Mainline South of Kyles Ln	-	15,053	-	-	22,177	-
NB Entrance Ramp from Dixie Hwy	2,500	2,261	9.6%	2,293	2,481	8.2%
NB Exit Ramp to Dixie Hwy	863	852	1.3%	1,269	1,395	9.9%
NB Mainline South of Dixie Hwy	14,014	13,658	2.5%	20,376	21,117	3.6%

Figure 3: AM Peak Volume Profile

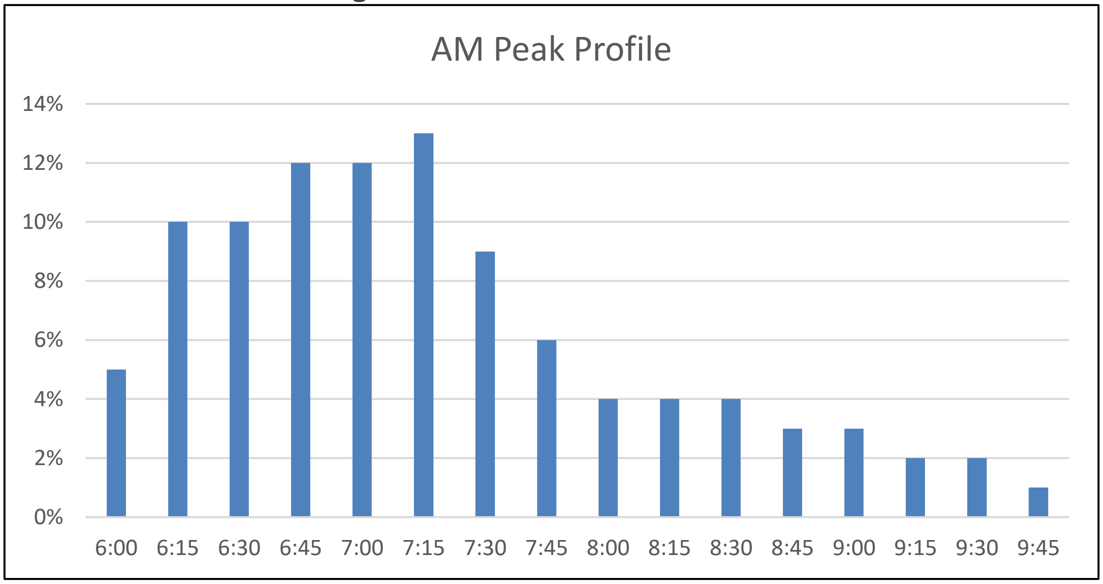
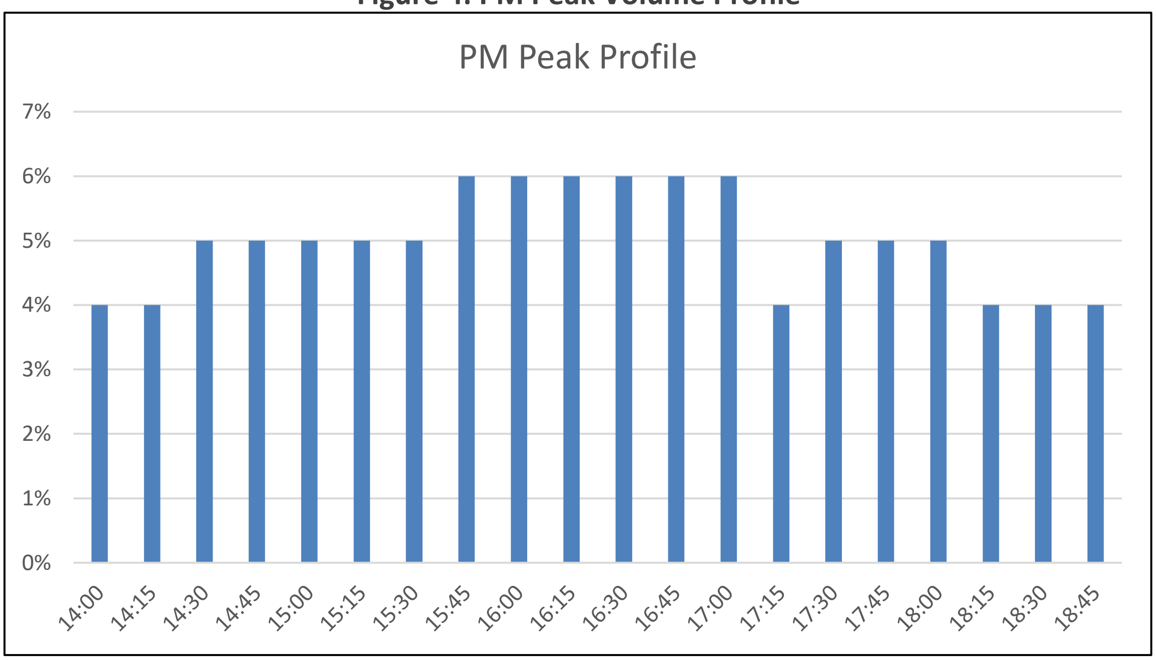


Figure 4: PM Peak Volume Profile



5.2 TRAVEL SPEEDS

Travel speeds on the I-71/I-75 corridor are obtained from NPMRDS (supplied by INRIX). The observed 2017 median weekday speeds are compared to the model speeds. **Figure 5- Figure 8** compares the speeds by period and direction. The models match the off-peak direction speeds for AM southbound and PM northbound. However, the travel delays for the peak directions do not match field conditions. The field observed travel speeds indicate queuing and delays leading to the Brent Spence Bridge, which are not replicated by the model. Additional model calibration is needed once the project advances to the next stage of analysis.

5.3 TRAVEL TIMES

Point-to-point travel time for I-71/I-75 between Dixie Hwy and the Western Hills Viaduct are summarized in **Table 3**. The model travel times are averaged over the peak period. The travel time range shows the high and low peak period travel time over 3 model runs. The modeled and observed travel times are compared as part of the model validation. As indicated for the travel speed comparison, the model travel time in the peak direction does not match field conditions while the off-peak travel time is a good representation of field conditions.

Table 3: Travel Time Validation

	NMPRDS Travel Time	Modeled Travel Time
I-75 Northbound – AM Peak	10.8 minutes	6.9-8.4 minutes
I-75 Southbound – AM Peak	7.6 minutes	6.7-8.3 minutes
I-75 Northbound – PM Peak	8.2 minutes	7.1-8.5 minutes
I-75 Southbound – PM Peak	14.0 minutes	6.8-8.9 minutes

Figure 5: AM Peak I-71/I-75 Northbound Speed Data Heat Map

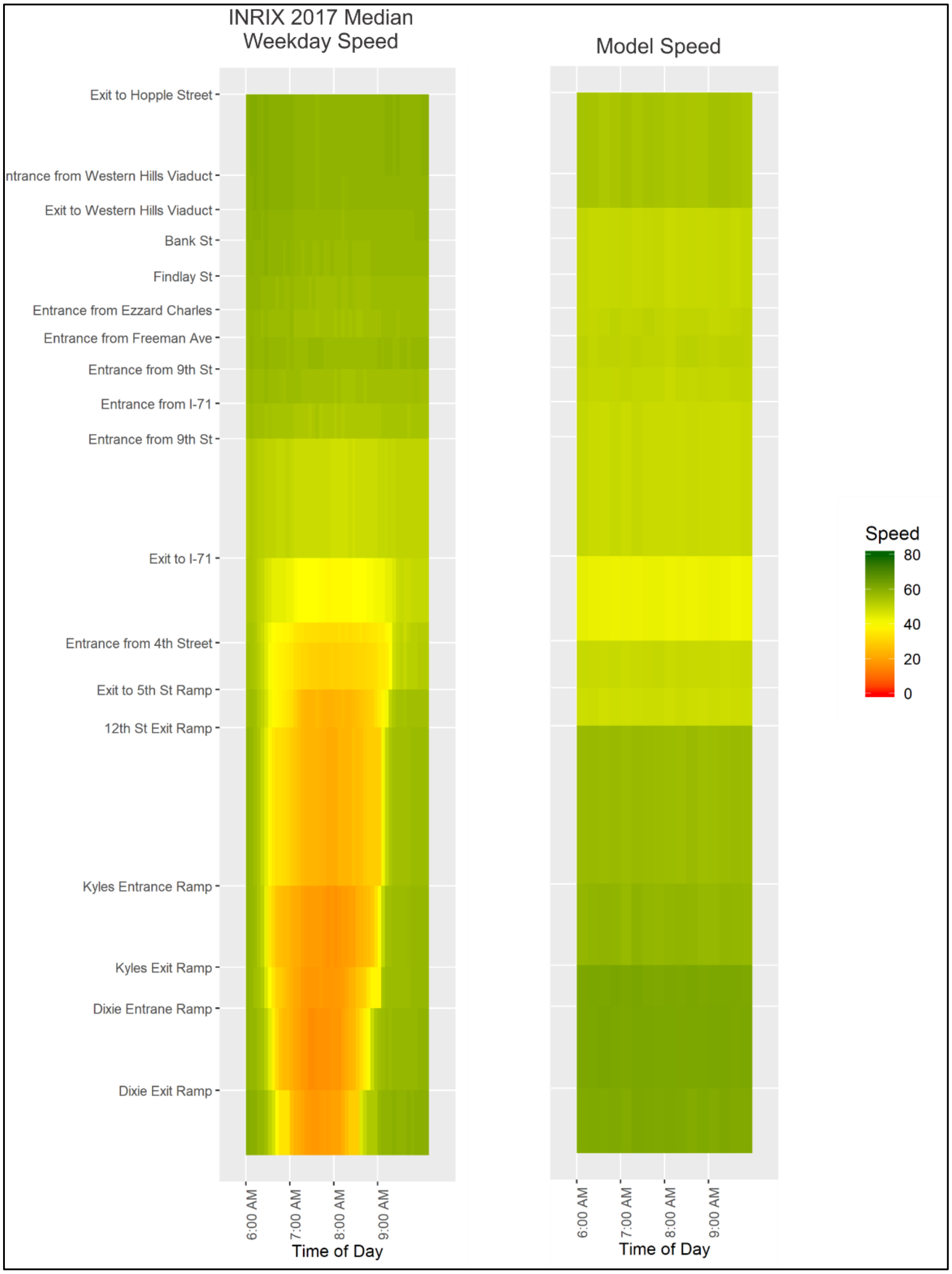


Figure 6: AM Peak I-71/I-75 Southbound Speed Data Heat Map

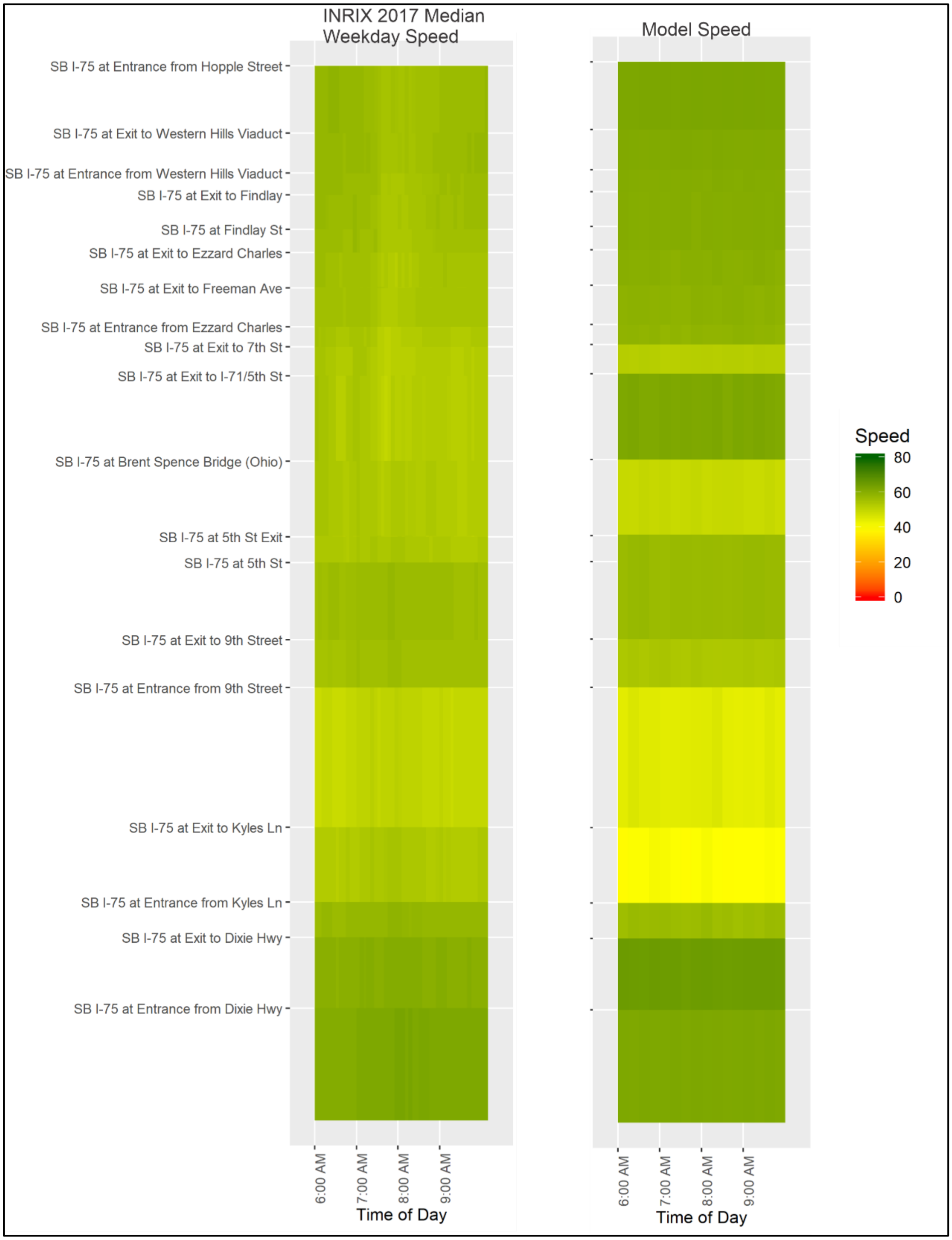


Figure 7: PM Peak I-71/I-75 Northbound Speed Data Heat Map

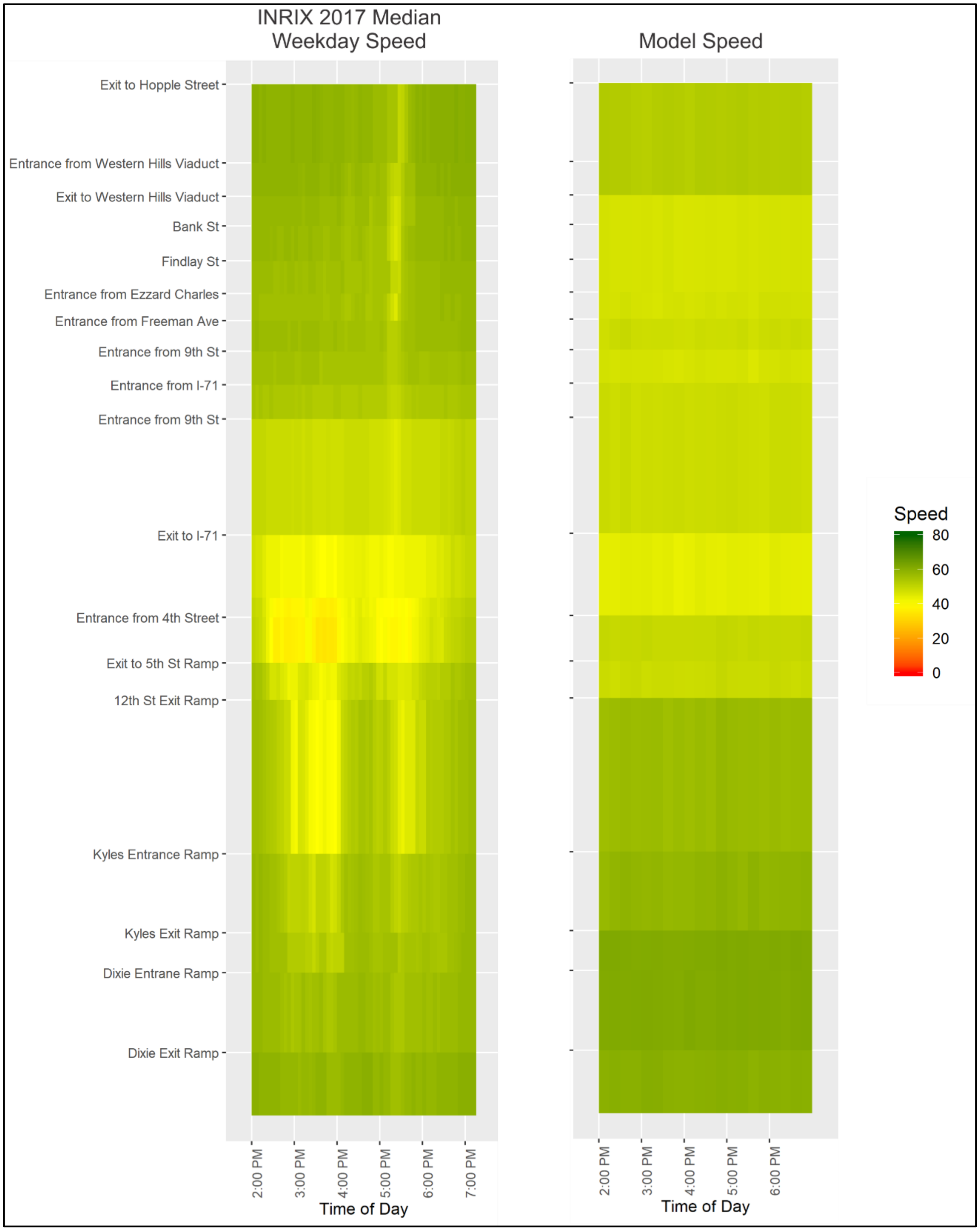
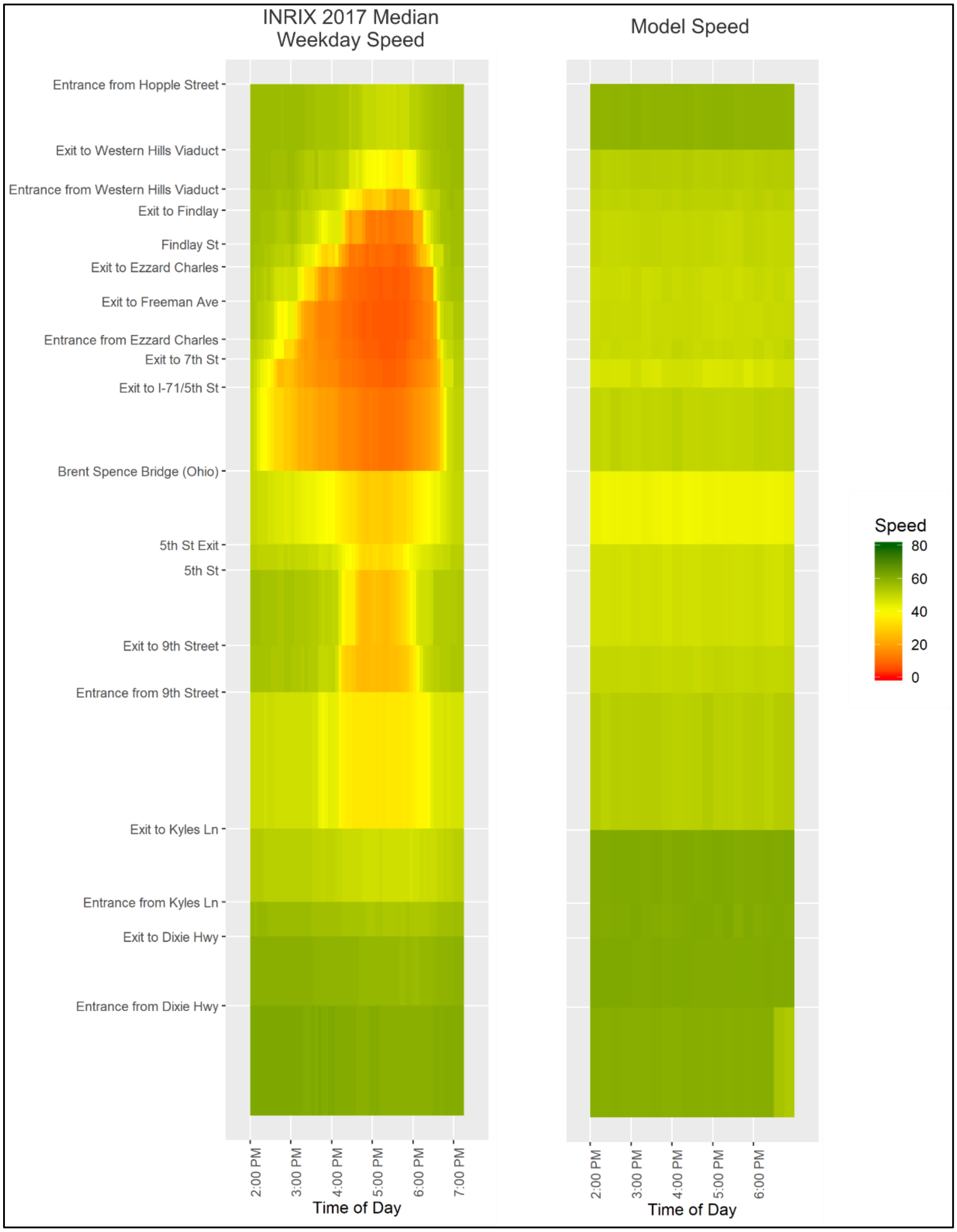


Figure 8: PM Peak I-71/I-75 Southbound Speed Data Heat Map



5.4 DEVIATIONS FROM DEFAULT VALUES

Lane connectivity bias is adjusted to replicate driver behavior when merging at an entrance ramp or at a lane drop. The default connectivity bias is 1.00. When the connectivity bias is reduced, it lowers lane utilization behaviors. The connectivity bias was reduced to 0.8 at the end of a merge lane or lane drop to change merging behavior, so drivers will merge as soon as possible rather than driving to the end of the lane taper.

Two additional road classes are added to the model to capture the differences between freeways near the urban core and freeways through transitioning/suburban areas. Urban Freeway 55 mph road class is developed to adjust for the reduced speeds observed near the Cincinnati urban core. A class for the Brent Spence Bridge is created to adjust for reduced capacity on the bridge due to the narrow lanes and minimal shoulder. The road classes are summarized in **Table 4.**

Table 4: Model Road Classes

Attribute	Default Freeway	Freeway (70 mph)	Urban Freeway (55 mph)
Saturation Flow Rate	2,400 veh/hr/ln	2,400 veh/hr/ln	1,900 veh/hr/ln
Speed Limit	65 mph	65 mph	55 mph
Free-flow Speed	70 mph	70 mph	60 mph
Desired Speed Distribution	Freeway (Default)	Freeway	Urban Freeway

The freeway desired speed distributions were adjusted to match off-peak speeds from NPMRDS, which approximate the free flow condition. The desired speed distribution describes how much faster or slower than the speed limit vehicles in the model drive and is expressed in percentage of drivers. The default freeway desired speed distribution in **Figure 9** was adjusted to include more vehicles driving below the posted speed limit and slightly more variation in speeds as shown in **Figure 10**. A new category was created for the urban freeways with a 55 mph speed limit to have even more variation in speeds and a trend towards driving above the speed limit as shown in **Figure 11**.

Figure 9:Default Freeway Speed Distribution

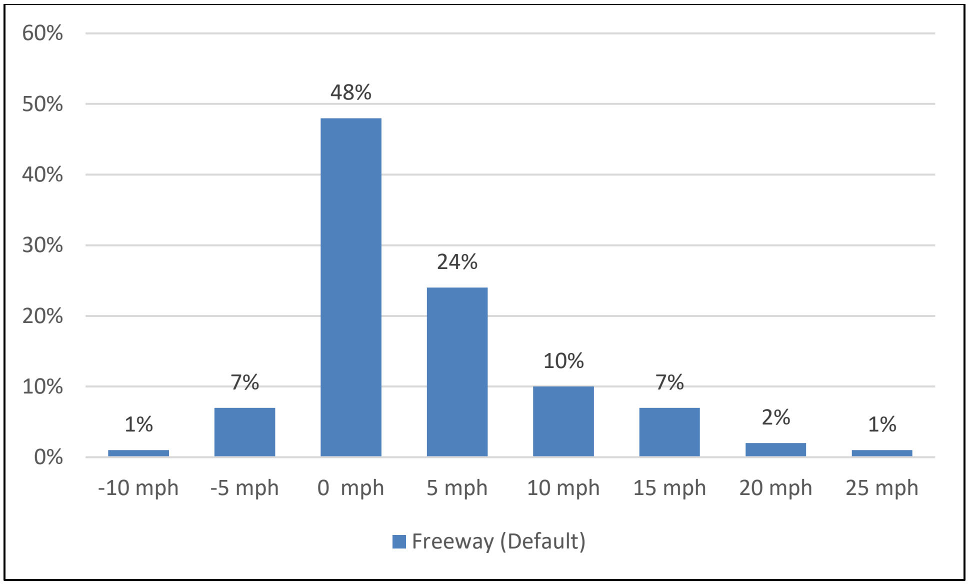


Figure 10: Adjusted Freeway (70 mph) Speed Distribution

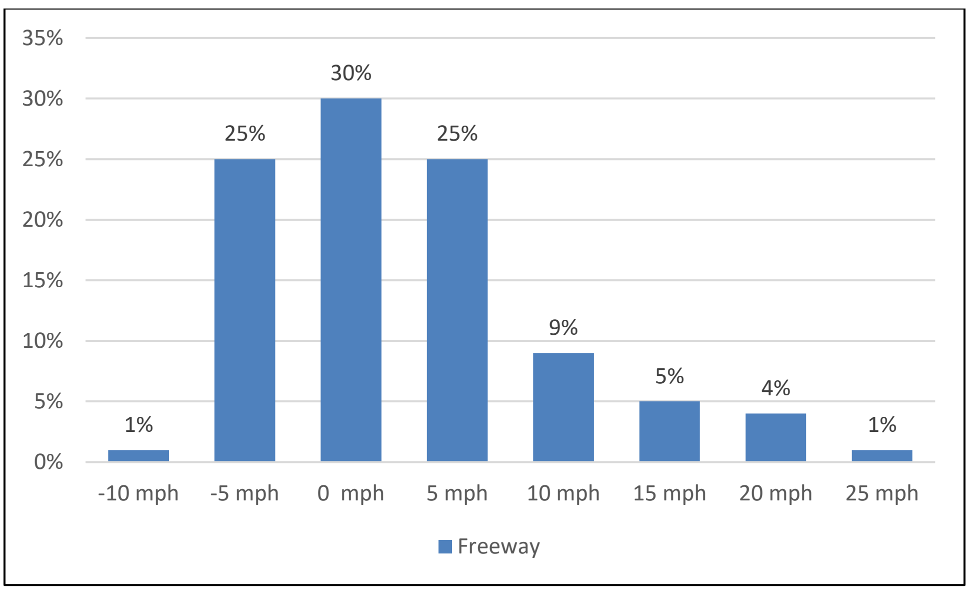
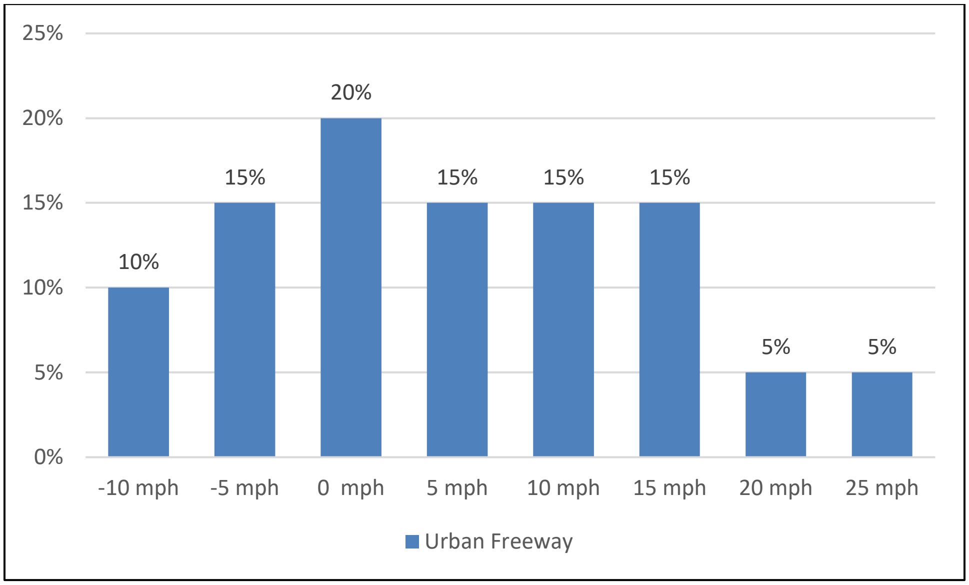


Figure 11: Urban Freeway (55 mph) Distribution



Critical headways for freeway merging was adjusted to increase the percentage of drivers that prefer a larger headway while merging. There are entrance ramps near the Ohio and Kentucky sides of the bridge that disrupt traffic flow. The default and adjusted critical headway parameters are shown in **Table 5.**

Table 5: Critical Headway

Critical Heady for Freeway Merging (seconds)	Default Percentage of Drivers	Adjusted Percentage of Drivers
0.2 sec	20%	10%
0.4 sec	50%	20%
0.6 sec	20%	50%
0.8 sec	10%	20%

Though the model does not fully depict slowdowns and recoveries during the peak periods, further adjustments were not made to the parameters. The adjusted critical headway and speed distribution inputs improved the calibration by decreasing modeled speeds (which is more comparable to observed speeds). Although the best available traffic counts and speed data were used for the calibration there are limitations on how this data should be used. The TransModeler default parameters are based on peer reviewed research and will not be adjusted beyond the limitations of the input data.

6. SCENARIO ANALYSIS SUMMARIES

The concepts developed at the performance-based design workshop in December 2019 were analyzed using the microsimulation model. The purpose of the analysis was to determine if these concepts for the I-71/I-75 system interchange and Ohio River crossing are viable and should be carried forward to the NEPA phase for further refinement. The concepts include improvements to the I-75 corridor to eliminate upstream and downstream bottlenecks that would restrict traffic flow through the project area. The purpose of this study is not to define improvements to the I-75 corridor, but to ensure the I-71/I-75 system interchange and bridge over the Ohio River can accommodate future traffic.

The level of service (LOS) and mainline freeway speeds during the peak hour are reported. The AM peak analysis covers 6:00 AM to 10:00 AM, and results are reported for the peak hour which occurs from 7:00 AM to 8:00 AM. The PM peak analysis covers 3:00 PM to 7:00 PM, and results are reported for the peak hour which occurs from 4:00 PM to 5:00 PM.

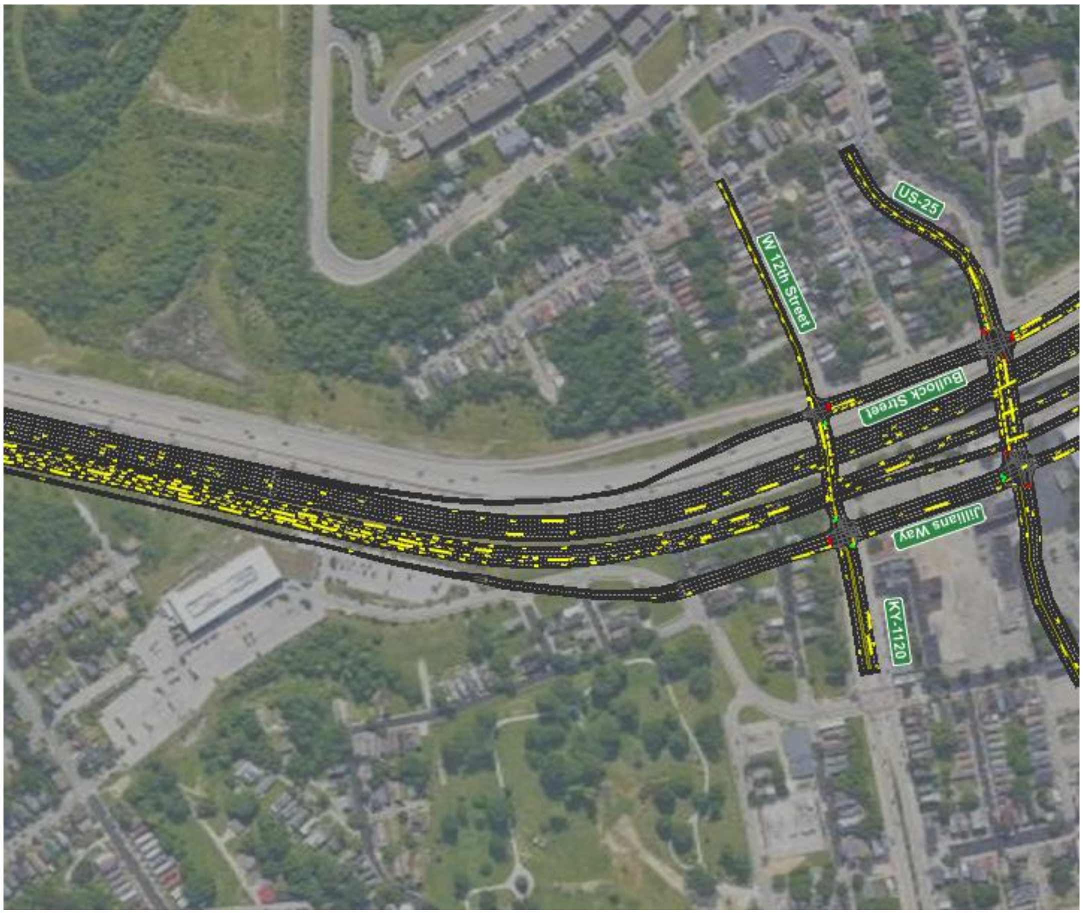
6.1 2040 CONCEPT W

Concept W has the best operations of the three concepts analyzed. Most of the freeway segments operate at a level of service of D or better with mainline speeds of 50 mph or greater. Line diagram summaries for Concept W are presented in the appendix and include details on the freeway level of service and peak hour traffic forecasts. The one segment with a level of service on the LOS D/LOS E threshold is the southbound exit to I-75 local (near Ezzard Charles). This diverge could be reconfigured as the concept is further refined to improve traffic operations.

6.2 2040 CONCEPT M

Concept M performed acceptably and can be improved as the concept is further developed. The major diverge at I-71/I-75 northbound performs at the LOS E/LOS F threshold and traffic forms a "rolling queue" as shown in **Figure 12**. The forecasted traffic to I-71 and I-75 at this diverge are nearly equal. In the current design, there are 5 lanes approaching the major diverge. I- 75 northbound is 3 lanes wide and there is a 2-lane ramp to I-71 northbound. A lane could be added on the ramp to I-71 northbound and the approaching middle lane could become an option lane. The desired 3-lane cross section on the existing bridge can be used if one of the 3 lanes on the ramp to I-71 northbound is dropped prior to the 4th Street entrance ramp.

Figure 12: Concept M in Kentucky During AM Peak



6.3 2040 CONCEPT WS

Initial analysis concluded that Concept WS is not a viable option. Concept WS is identical to Concept W in Ohio but has "superstreets" in Kentucky that connects the local roadways. The superstreets in this concept move trips that would otherwise be on an access-controlled freeway ramp system through a series of signalized intersections. The traffic signals could not accommodate the traffic moving through the superstreets and the traffic on intersecting east-west local roads. The traffic delays observed for Concept WS are highlighted in Figure 13.

Figure 13: Concept WS Superstreets in Kentucky During AM Peak

7. RECOMMENDATIONS

Traffic analysis of Concept W and Concept M show reasonable operation and are both recommended for further study in the BSB Project. The corresponding geometric design and cost estimate analysis for each concept is shown in the *Analysis of Design Concepts* report, also completed in April 2020. Concept WS is not recommended for further study. Refinement of the model calibration and traffic analyses should be made concurrent with any updated geometric design and constructability efforts.

Data collection is the most critical action for the next phase of model calibration. Updated counts, origin-destination data from a source such as Streetlight, and a comprehensive speed/travel time data analysis using NPMRDS (INRIX) are recommended. All this data can be used to satisfy updated modeling guidelines from FHWA Analysis Toolbox Volume III. Specifically, this data can be used for cluster analysis, which group data into similar type days based on demand, speed, queuing patterns, and weather conditions. The models can then be calibrated to various conditions instead of the traditional model that tries to replicate an average condition. With more robust data, the headway parameters can be further adjusted to improve calibration. Further refinements to the model geometry, including elevation throughout the corridor, are also recommended.

2040 Concept M Freeway Capacity Analysis Summary

I-75 Northbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
NB Mainline (at I-275)	F-101	Mainline	37.4	36.2 - 38.8	58	E	22.6	22.1 - 23.3	62	C
NB Entrance Ramp from I-275	R-01	Merge	26.8	25.8 - 27.2	--	C	19.9	18 - 21.4	--	B/C
NB Mainline	F-102	Mainline	25.7	24.9 - 26.4	61	C/D	18.7	18.5 - 19.2	62	C
NB Exit Ramp to Buttermilk Pk.	R-02	Diverge	28.0	26.4 - 30	--	C/D	21.5	20.8 - 22.4	--	C
NB Mainline (at Buttermilk Pk.)	F-103	Mainline	26.8	26.3 - 27.2	62	D	21.2	20.8 - 21.5	62	C
NB Entrance Ramp from Buttermilk Pk.	R-03	Merge	28.1	27.2 - 29.4	--	C/D	21.9	20.8 - 22.5	--	C
NB Mainline south of Dixie Hwy	F-104	Mainline	23.3	22.5 - 23.9	61	C	18.4	18 - 19.4	62	C
NB Exit Ramp to Dixie Hwy	R-04	Diverge	25.7	25.5 - 26.1	--	C	20.3	19.4 - 21.7	--	C
NB Mainline (at US 25/Dixie Hwy/Kyles Lane) (3 lanes)	F-105	Mainline	26.6	25.9 - 27.1	62	C/D	20.8	20.3 - 21.4	63	C
NB Mainline (at US 25/Dixie Hwy/Kyles Lane) (4 lanes)	F-106	Mainline	26.7	26.2 - 27.1	62	D	20.8	20.3 - 21.5	62	C
NB Entrance Ramp from Dixie Hwy	R-05	Merge[1]	25.3	24.4 - 25.9	--	C	20.9	19.5 - 21.9	--	C
NB Entrance Ramp from Kyle	R-06	Merge[1]	23.5	22.7 - 24.2	--	C	19.2	18.6 - 19.7	--	B
NB Mainline	F-107	Mainline	26.4	22.9 - 32.8	56	C/D	19.1	18.9 - 19.3	63	C
NB Exit Ramp to MLK Jr Blvd/US 25/Pike St/9th St	R-07	Diverge	38.5	28.9 - 49.6	--	D/F	21.7	21.1 - 22.6	--	C
NB Mainline	F-108	Mainline	55.0	42.8 - 68.6	30	E/F	28.4	28 - 28.8	46	D
NB Exit Ramp to Local Lanes/I-71 EB	R-08	Diverge[1]	44.5	43.4 - 45.7	--	E/F	32.1	30.7 - 33.8	--	D
NB Mainline	F-109	Mainline	25.7	24.5 - 26.6	50	C/D	21.2	20.6 - 21.6	51	C
NB Entrance Ramp from MLK Jr Blvd/US 25/Pike St/9th St	R-09	Merge[1]	23.4	22.2 - 24.7	--	C	19.6	19 - 20.1	--	B/C
NB Mainline on New Bridge over Ohio River	F-110	Mainline	23.2	22.3 - 24.1	49	C	19.6	18.8 - 19.8	50	C
NB Exit Ramp to 5th St/6th St	R-10	Diverge[1]	25.1	22 - 30.4	--	C/D	25.7	21.6 - 32	--	C/D
NB Mainline at 9th St Viaduct	F-111	Mainline	25.1	24.1 - 27.1	49	C/D	21.5	20.9 - 22.4	49	C
NB Entrance Ramp from Northbound Local Lanes	R-11	Merge[1]	19.5	17.3 - 20.5	--	B/C	18.5	18 - 18.9	--	B
NB Mainline at Ezzard Charles Dr	F-112	Mainline	18.5	16.9 - 19.3	50	B/C	18.9	17.8 - 20.7	51	C
NB Entrance Ramp from Freeman Ave	R-12	Merge[1]	18.3	17 - 19.5	--	B	18.8	18 - 20.6	--	B/C
NB Mainline	F-113	Mainline	21.7	20.3 - 23.4	50	C	22.4	21 - 23.5	50	C
NB Exit Ramp to Western Hills Viaduct	R-13	Diverge[1]	26.3	23.8 - 28.2	--	C/D	27.0	25.6 - 27.7	--	C
NB Mainline north of Western Hills Viaduct	F-114	Mainline	19.8	19.3 - 20.6	52	C	19.6	18.5 - 20.1	51	C

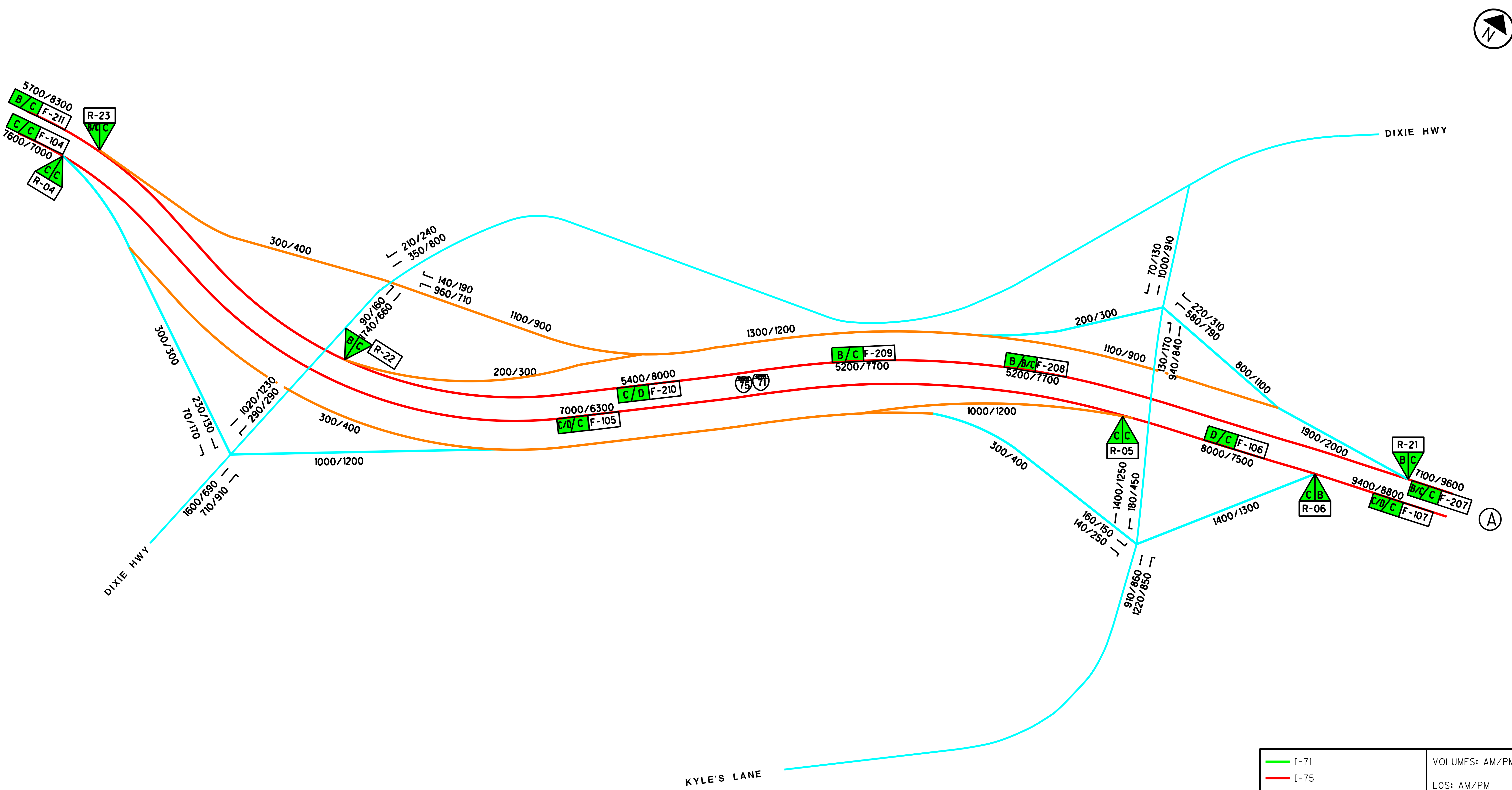
2040 Concept M Freeway Capacity Analysis Summary

I-75 Southbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
SB Mainline north of Western Hills Viaduct	F-201	Mainline	27.6	26.8 - 28.4	50	D	21.0	20.4 - 21.3	52	C
SB Entrance Ramp from Western Hills Viaduct	R-14	Merge[1]	26.2	26 - 26.4	--	C	19.7	18.8 - 21.7	--	B/C
SB Mainline south of Western Hills Viaduct	F-202	Mainline	25.9	24.9 - 27.5	49	C/D	19.8	19.1 - 20.7	50	C
SB Exit Ramp to Western Avenue	R-15	Diverge	26.6	24.8 - 27.5	--	C	21.8	21.1 - 23.3	--	C
SB Exit Ramp to I-75 Local	R-16	Diverge[1]	30.9	27.4 - 33.8	--	C/D	25.9	21.7 - 28.2	--	C/D
SB Mainline	F-203	Mainline	33.5	32 - 38.2	45	D/E	31.5	30.8 - 32.6	45	D
SB Exit to I-71 EB	R-17	Diverge	42.2	39.1 - 47.3	--	E/F	42.9	41.5 - 44	--	E
SB Mainline on New Bridge over Ohio River	F-204	Mainline	20.5	20 - 21.4	50	C	20.6	20.1 - 21.4	50	C
SB Entrance Ramp from I-75 Local Lanes	R-18	Merge[1]	18.3	17.4 - 19.5	--	B	19.9	18.7 - 21.1	--	B/C
SB Entrance Ramp from I-71 Southbound	R-19	Merge[1]	19.5	19.2 - 19.9	--	B	21.4	21.1 - 21.9	--	C
SB Mainline	F-205	Mainline	19.5	19.2 - 19.9	52	C	21.4	21.1 - 21.9	52	C
SB Entrance Ramp from Bullock St	R-20	Merge[1]	15.4	14.9 - 16.2	--	B	18.2	17.9 - 18.9	--	B
SB Mainline	F-207	Mainline	18.5	17.1 - 19.5	63	B/C	21.7	19.8 - 22.8	62	C
SB Exit Ramp to Kyles/Dixie C-D Road	R-21	Diverge	17.6	17 - 18.5	--	B	22.0	19.6 - 24.9	--	C
SB Mainline (6 Lanes)	F-208	Mainline	13.3	12.4 - 14.3	64	B	17.3	16.5 - 18	63	B/C
SB Mainline (5 Lanes)	F-209	Mainline	16.2	15.3 - 16.7	61	B	21.3	20.6 - 22.8	59	C
SB Mainline (4 Lanes)	F-210	Mainline	20.4	19.6 - 20.8	61	C	26.5	26 - 27	59	D
SB Entrance Ramp from Kyles/Dixie C-D Road	R-22	Merge[1]	17.0	15.6 - 18.1	--	B	22.6	21.3 - 24.4	--	C
SB Entrance Ramp from Dixie Hwy	R-23	Merge	18.3	15.9 - 21	--	B/C	24.0	23.3 - 25.3	--	C
SB Mainline	F-211	Mainline	17.0	16.6 - 17.3	62	B	22.2	22.1 - 22.5	61	C
SB Exit Ramp to Buttermilk Pk.	R-24	Diverge	18.9	17.6 - 20.1	--	B/C	24.3	23.4 - 25.1	--	C
SB Mainline	F-212	Mainline	19.0	17.2 - 20.2	62	B/C	25.8	24.9 - 27.1	61	C/D
SB Entrance Ramp from Buttermilk Pk.	R-25	Merge	18.9	16.9 - 21	--	B/C	24.5	23.7 - 25.3	--	C
SB Mainline north of Buttermilk Pk.	F-213	Mainline	18.1	17.5 - 18.8	61	B/C	23.9	23.5 - 24.5	59	C
SB Exit Ramp to I-275	R-26	Diverge	18.5	16.5 - 20.4	--	B/C	26.4	25.5 - 27	--	C
SB Mainline at I-275	F-214	Mainline	21.9	21.3 - 22.5	62	C	28.2	27.8 - 28.6	61	D

2040 Concept M Freeway Capacity Analysis Summary

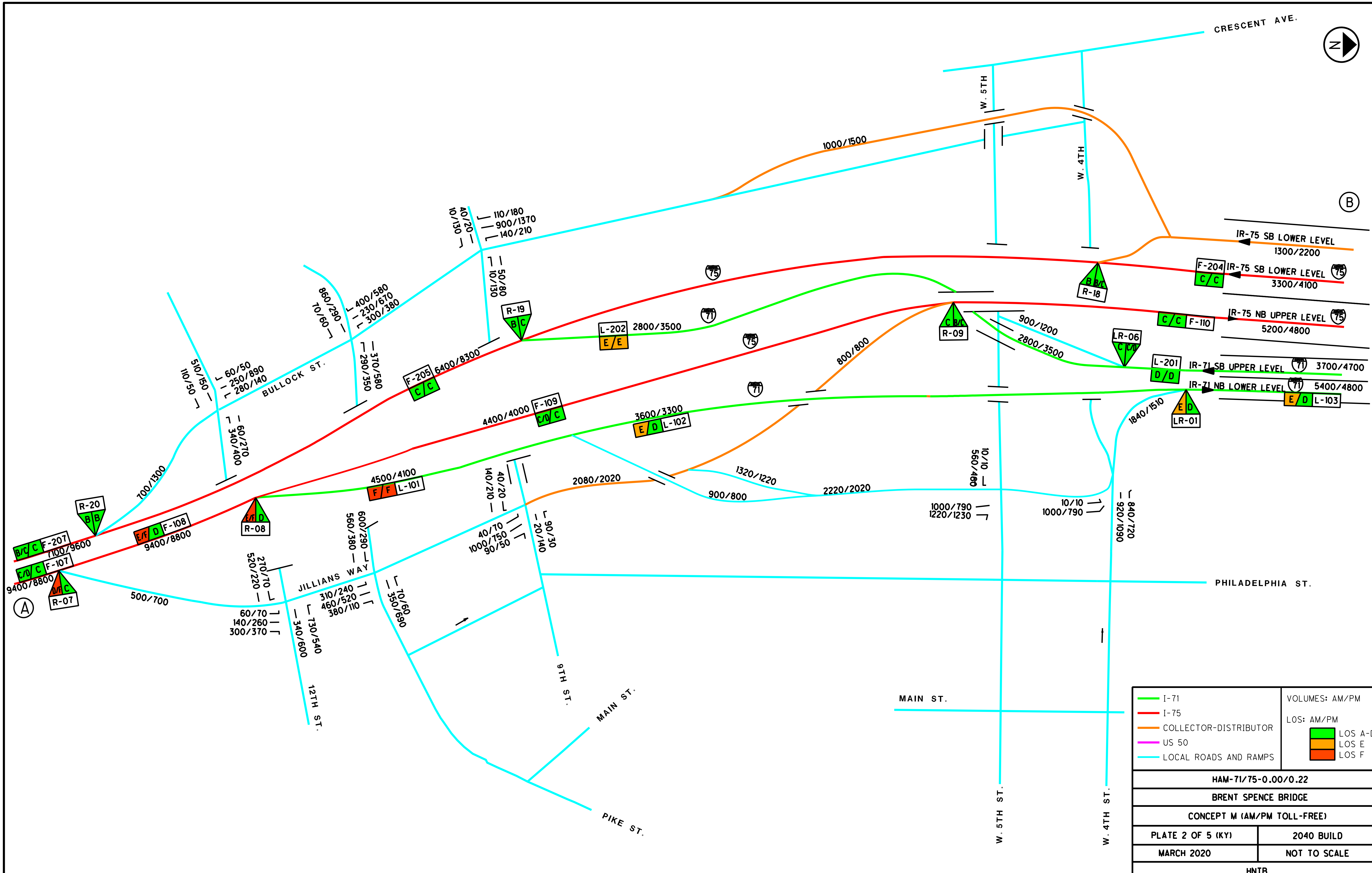
I-71 Local Northbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
I-71 Local Northbound (mainline)	L-101	Mainline	59.9	59 - 60.7	33	F	47.2	45.6 - 50.2	36	F
After Exit to W 5th Street (mainline)	L-102	Mainline	39.1	38.5 - 39.7	40	E	33.2	32.1 - 34.2	40	D
Ramp from 4th Street	LR-01	Merge[1]	38.9	36.6 - 41.6	--	E	29.1	27.2 - 30.4	--	D
I-71 over Ohio River	L-103	Mainline	37.0	36.6 - 37.3	43	E	28.8	27.4 - 30.1	45	D
Exit to 6th Street	LR-02	Diverge[1]	57.4	55.1 - 60.2	--	F	45.0	40.5 - 47.1	--	E/F
I-71 Northbound	L-104	Mainline	40.5	38.9 - 42.3	36	E	31.5	30.3 - 32.4	38	D
I-71 Northbound Ramp Merge	LR-03	Merge[1]	31.5	30.1 - 32.6	--	D	27.2	26.2 - 28.5	--	C/D

I-71 Local Southbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
I-71 SB Major Diverge	LR-04	Diverge[1]	29.9	27.7 - 31.6	--	C/D	27.4	25.2 - 29.5	--	C/D
Ramp from 3rd St	LR-05	Merge[1]	27.0	25.6 - 27.8	--	C	25.8	24 - 27.3	--	C
I-71 Southbound Ramp	L-203	Mainline	30.5	29.4 - 31	42	D	25.0	23.9 - 26.2	43	C/D
SB I-71 local over Ohio River	L-201	Mainline	26.8	26 - 27.6	46	D	27.2	26.3 - 28.5	45	D
Ramp to 5th Street	LR-06	Diverge[1]	26.8	26 - 27.6	--	C	27.2	26.3 - 28.5	--	C/D
I-71 on to merge with I-75	L-202	Mainline	35.7	35 - 37.4	37	E	38.3	36.8 - 39.3	37	E

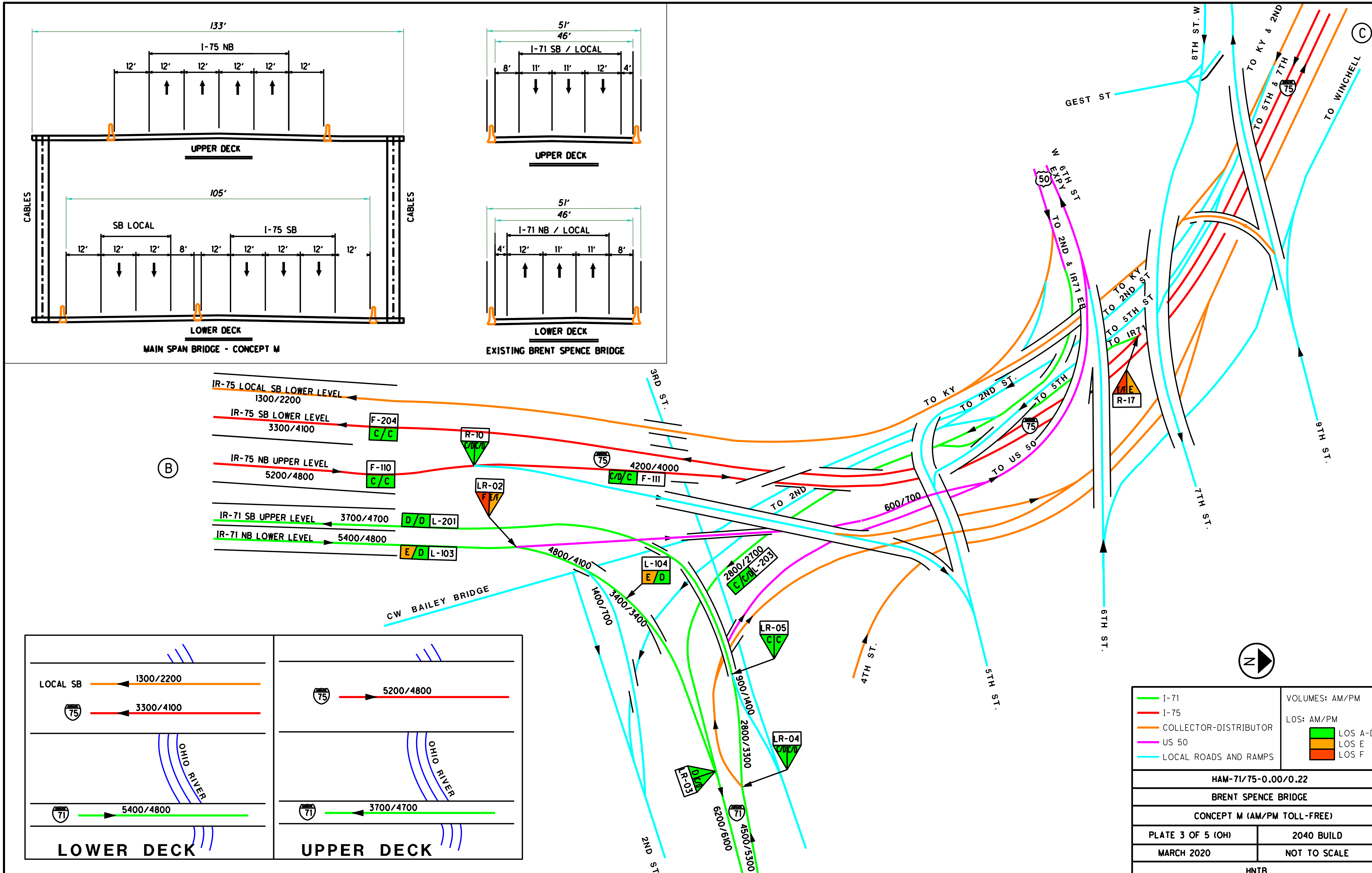


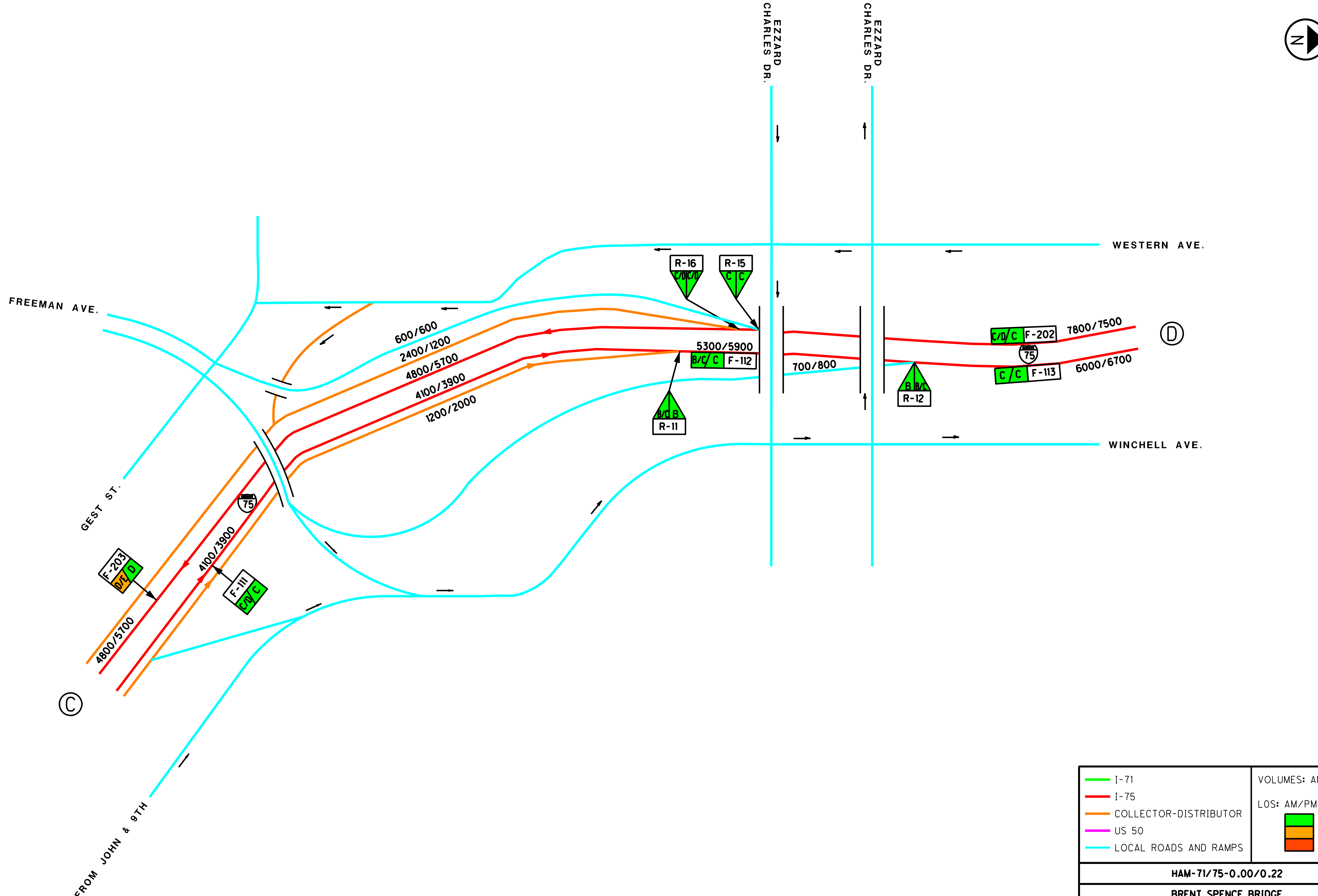
I-71	VOLUMES: AM/PM
I-75	LOS: AM/PM
COLLECTOR-DISTRIBUTOR	LOS A-D
US 50	LOS E
LOCAL ROADS AND RAMPS	LOS F

HAM-71/75-0.00/0.22	
BRENT SPENCE BRIDGE	
CONCEPT M (AM/PM TOLL-FREE)	
PLATE 1 OF 5 (KY)	2040 BUILD
MARCH 2020	NOT TO SCALE
HNTB	



CRESCENT AVE.
W. 5TH
W. 4TH
1000/1500
IR-75 SB LOWER LEVEL
1300/2200
F-204
C/C
IR-75 SB LOWER LEVEL
3300/4100
R-18
C/C F-110
IR-75 NB UPPER LEVEL
5200/4800
LR-06
L-201
D/D
IR-71 SB UPPER LEVEL
3700/4700
IR-71 NB LOWER LEVEL
5400/4800
E/D L-103
LR-01
1840/1510
R-09
900/1200
2800/3500
800/800
L-202
2800/3500
E/E
R-19
B/C
110/180
900/1370
140/210
40/20
10/130
50/80
10/130
F-205
6400/8300
C/C
860/290
70/60
400/580
230/670
300/380
370/580
290/350
BULLOCK ST.
510/150
110/50
60/50
250/890
280/140
60/270
340/400
700/1300
R-20
B/B
F-207
B/C C
7100/9600
F-107
C/D C
9400/8800
R-07
D/F C
F-108
E/F D
9400/8800
R-08
E/F D
F-109
C/D C
4400/4000
3600/3300
E/D L-102
4500/4100
F/F L-101
140/210
40/20
2080/2020
1320/1220
900/800
2220/2020
10/10
560/480
1000/790
1220/1230
10/10
1000/790
920/1090
840/720
600/290
560/380
40/70
1000/750
90/50
20/140
90/30
500/700
JILLIANS WAY
270/70
520/220
310/240
460/520
380/110
70/60
350/690
60/70
140/260
300/370
340/600
730/540
12TH ST.
9TH ST.
MAIN ST.
PIKE ST.
PHILADELPHIA ST.
MAIN ST.
W. 5TH ST.
W. 4TH ST.
A
B
N
I-71
I-75
COLLECTOR-DISTRIBUTOR
US 50
LOCAL ROADS AND RAMPS
VOLUMES: AM/PM
LOS: AM/PM
LOS A-D
LOS E
LOS F
HAM-71/75-0.00/0.22
BRENT SPENCE BRIDGE
CONCEPT M (AM/PM TOLL-FREE)
PLATE 2 OF 5 (KY)
2040 BUILD
MARCH 2020
NOT TO SCALE
HNTB


133'
I-75 NB
12' 12' 12' 12' 12' 12'
UPPER DECK
CABLES
105'
SB LOCAL
I-75 SB
12' 12' 12' 8' 12' 12' 12' 12' 12'
LOWER DECK
MAIN SPAN BRIDGE - CONCEPT M
51'
46'
I-71 SB / LOCAL
8' 11' 11' 12' 4'
UPPER DECK
I-71 NB / LOCAL
4' 12' 11' 11' 8'
LOWER DECK
EXISTING BRENT SPENCE BRIDGE
IR-75 LOCAL SB LOWER LEVEL
1300/2200
IR-75 SB LOWER LEVEL
3300/4100
F-204
C/C
IR-75 NB UPPER LEVEL
5200/4800
F-110
C/C
R-10
C/D C/D
IR-71 SB UPPER LEVEL
3700/4700
D/D L-201
IR-71 NB LOWER LEVEL
5400/4800
E/D L-103
LR-02
F E/F
75
4200/4000
C/D C F-111
3RD ST.
CW BAILEY BRIDGE
4800/4100
1400/700
3400/3400
L-104
E/D
2800/2700
C C/D L-203
LR-05
C C
900/1400
2800/3300
LR-04
C/D C/D
LR-03
D/D
6200/6100
71
4500/5300
2ND ST.
4TH ST.
5TH ST.
600/700
TO 2ND
TO KY
TO 2ND ST.
TO 5TH
TO US 50
W 6TH ST
50 EXPY
TO 2ND & IR71 EB
TO KY
TO 2ND ST
TO 5TH ST
TO IR71
E/F E
R-17
6TH ST.
7TH ST.
9TH ST.
8TH ST. W
GEST ST
TO KY & 2ND
TO 5TH & 7TH
TO WINCHELL
C
B
N
LOCAL SB
1300/2200
3300/4100
OHIO RIVER
5400/4800
LOWER DECK
5200/4800
3700/4700
UPPER DECK
I-71
I-75
COLLECTOR-DISTRIBUTOR
US 50
LOCAL ROADS AND RAMPS
VOLUMES: AM/PM
LOS: AM/PM
LOS A-D
LOS E
LOS F
HAM-71/75-0.00/0.22
BRENT SPENCE BRIDGE
CONCEPT M (AM/PM TOLL-FREE)
PLATE 3 OF 5 (OH)
2040 BUILD
MARCH 2020
NOT TO SCALE
HNTB



I-71	VOLUMES: AM/PM
I-75	LOS: AM/PM
COLLECTOR-DISTRIBUTOR	LOS A-D
US 50	LOS E
LOCAL ROADS AND RAMPS	LOS F

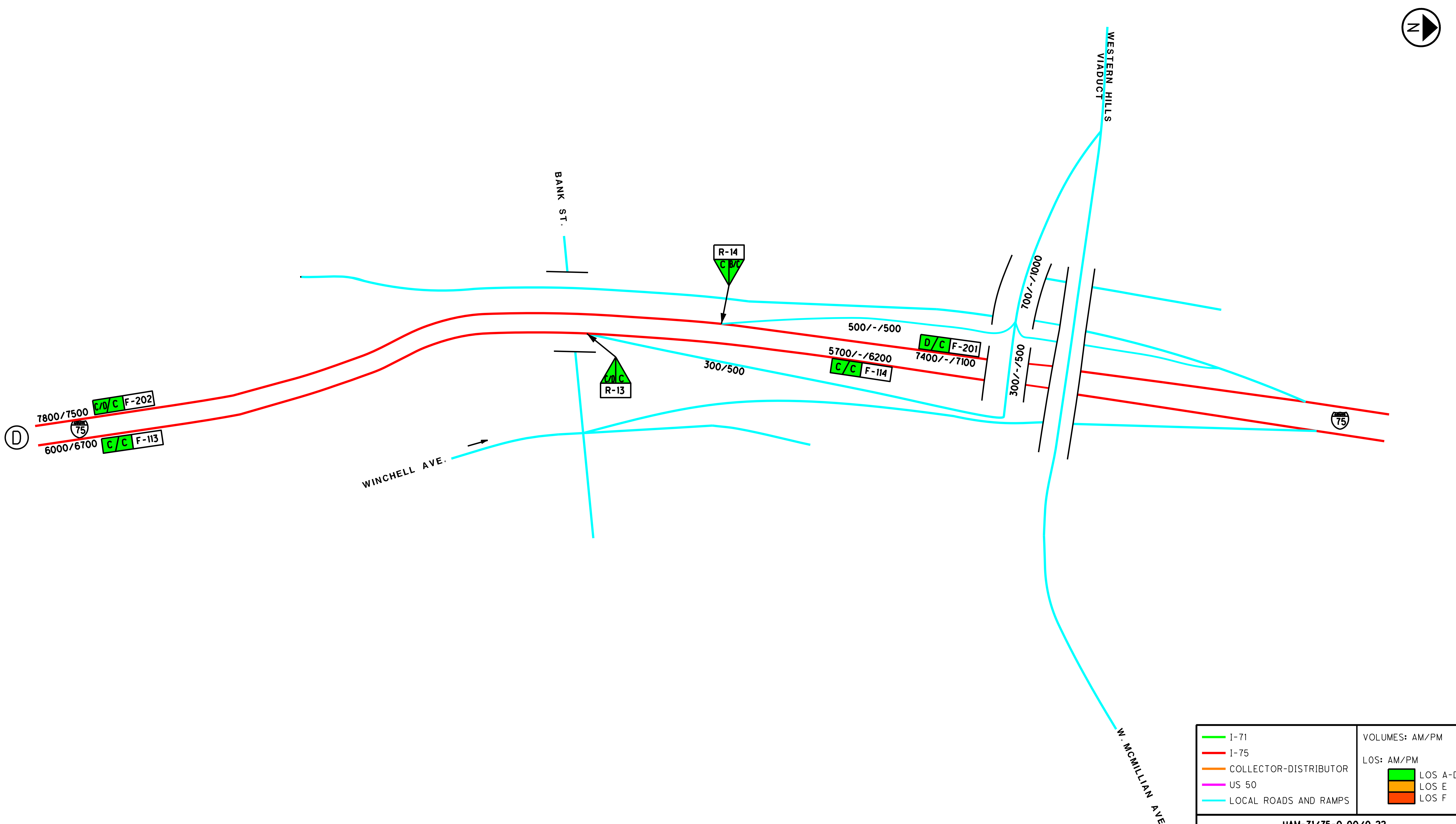
HAM-71/75-0.00/0.22

BRENT SPENCE BRIDGE

CONCEPT M (AM/PM TOLL-FREE)

PLATE 4 OF 5 (OH)	2040 BUILD
MARCH 2020	NOT TO SCALE

HNTB



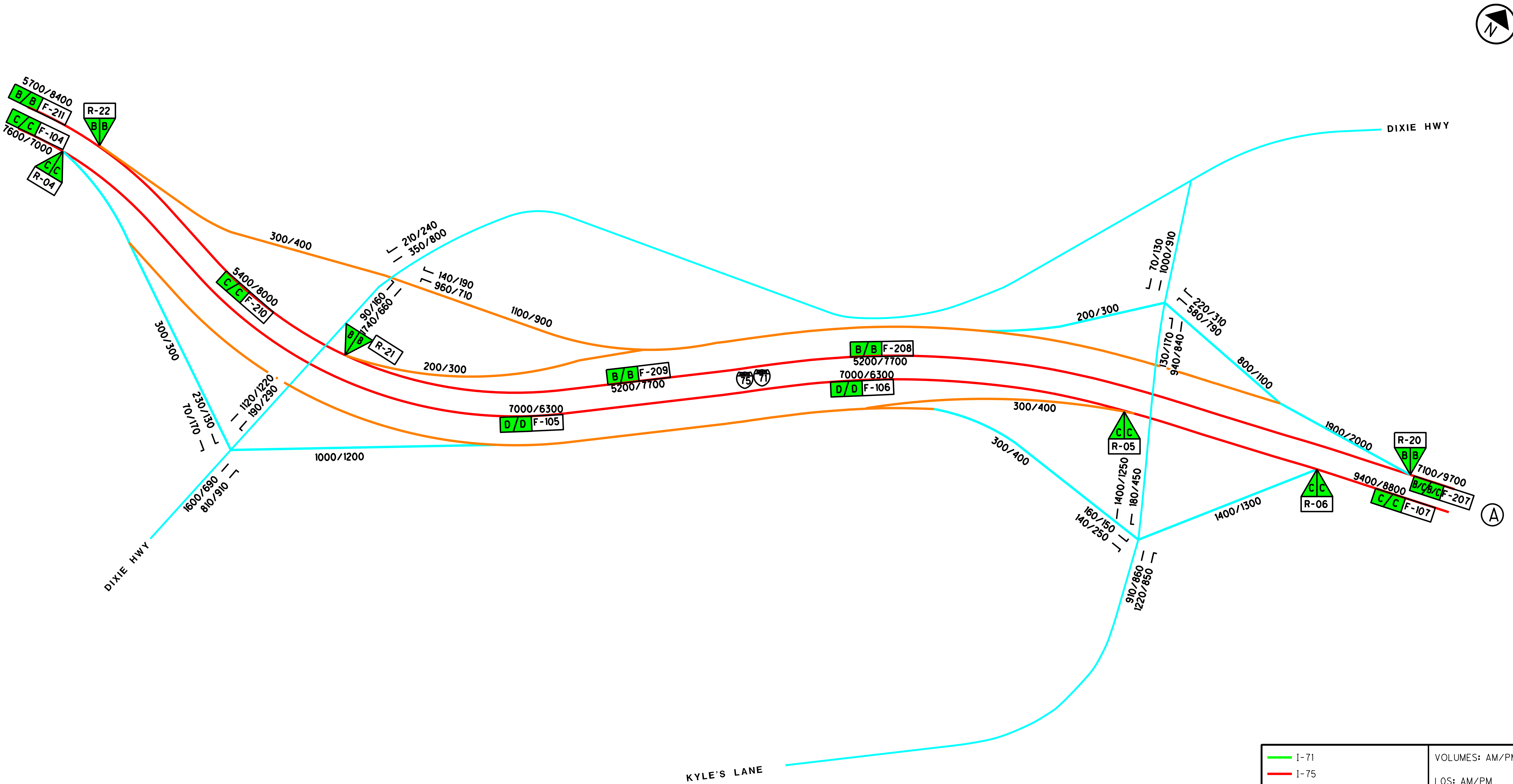
HAM-71/75-0.00/0.22	
BRENT SPENCE BRIDGE	
CONCEPT M (AM/PM TOLL-FREE)	
PLATE 5 OF 5 (OH)	2040 BUILD
MARCH 2020	NOT TO SCALE
HNTB	

2040 Concept W Freeway Capacity Analysis Summary

I-75 Northbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
NB Mainline (at I-275)	F-101	Mainline	37.3	36.3 - 38.4	59	E	21.9	21.5 - 22.5	64	E
NB Entrance Ramp from I-275	R-01	Merge	27.1	25.9 - 28.4	--	C/D	25.3	23.8 - 26.5	--	C/D
NB Mainline	F-102	Mainline	25.4	24.6 - 26.1	62	C/D	23.7	22.9 - 24.4	62	C/D
NB Exit Ramp to Buttermilk Pk.	R-02	Diverge	27.2	25.7 - 28.1	--	C/D	26.6	24.9 - 28.3	--	C/D
NB Mainline (at Buttermilk Pk.)	F-103	Mainline	26.1	25.6 - 26.7	63	C/D	26.9	26.2 - 27.3	63	C/D
NB Entrance Ramp from Buttermilk Pk.	R-03	Merge	25.1	24.6 - 25.7	--	C	24.6	22.9 - 26.6	--	C
NB Mainline south of Dixie Hwy	F-104	Mainline	23.0	22.5 - 23.7	63	C	31.4	30.3 - 31.9	59	C
NB Exit Ramp to Dixie Hwy	R-04	Diverge	23.8	22.4 - 26.1	--	C	32.2	30.5 - 33.4	--	C
NB Mainline (at US 25/Dixie Hwy/Kyles Lane) (3 lanes)	F-105	Mainline	26.7	26.4 - 27.1	63	D	26.7	25.2 - 27.8	63	D
NB Mainline (at US 25/Dixie Hwy/Kyles Lane) (4 lanes)	F-106	Mainline	26.4	26 - 27.1	63	D	19.5	19.1 - 20.1	65	D
NB Entrance Ramp from Dixie Hwy	R-05	Merge[1]	25.8	24.7 - 26.8	--	C	19.6	17.4 - 21.3	--	C
NB Entrance Ramp from Kyle	R-06	Merge[1]	24.3	23.2 - 24.9	--	C	18.5	17.9 - 19.9	--	C
NB Mainline	F-107	Mainline	23.4	22.6 - 24.4	62	C	18.5	18.3 - 18.9	64	C
NB Exit Ramp to MLK Jr Blvd/US 25/Pike St/9th St/Brent Spence Bridge	R-07	Diverge	28.6	27.8 - 29.2	--	C/D	21.8	20.4 - 22.3	--	C/D
NB Mainline on New Bridge over Ohio River	F-108	Mainline	23.6	22.8 - 24.5	51	C	19.6	17.9 - 21.6	52	C
NB Exit Ramp to NB I-71/EB US 50	R-08	Diverge[1]	26.9	25.1 - 28.1	--	C/D	23.0	22 - 23.9	--	C/D
EB I-71	F-109a	Diverge[2]	29.8	26.8 - 33	--	C/D	26.8	25.5 - 27.4	--	C/D
EB Entrance Ramp from I-71 SB	R-08a	Diverge[3]	27.8	27 - 28.6	--	C/D	23.4	22.8 - 23.9	--	C/D
NB I-71 Diverge	R-08b	Diverge[4]	20.2	19.6 - 21.1	--	B/C	20.1	19.1 - 21	--	B/C
NB Mainline	F-109	Mainline	23.5	22.4 - 24	50	C	18.8	18.2 - 19.1	51	C
NB Entrance Ramp from 3rd Street	R-09	Merge	27.4	26.3 - 29	--	C/D	25.3	22.8 - 27.8	--	C/D
NB Mainline	F-110	Mainline	26.3	25.9 - 27.3	51	C/D	23.1	22.4 - 23.5	52	C/D
NB Entrance Ramp from CD (I-71 SB/ US 50 WB/ 4th and 6th)	R-10	Merge[1]	18.2	16 - 20.5	--	B/C	17.6	16.6 - 19	--	B/C
NB Mainline	F-111	Mainline	18.2	17.5 - 19.5	53	B/C	18.3	17.4 - 19.1	53	B/C
NB Entrance Ramp from Freeman Ave	R-11	Merge	17.8	16.4 - 18.9	--	B	17.4	16 - 19.1	--	B
NB Mainline	F-112	Mainline	20.8	20.3 - 21.5	53	C	20.1	19.4 - 20.8	52	C
NB Exit Ramp to Western Hills Viaduct	R-12	Diverge	26.2	23.4 - 28.5	--	C/D	24.7	22.4 - 26	--	C/D
NB Mainline north of Western Hills Viaduct	F-113	Mainline	19.8	19.4 - 20.1	53	C	18.5	17.8 - 19.4	54	C

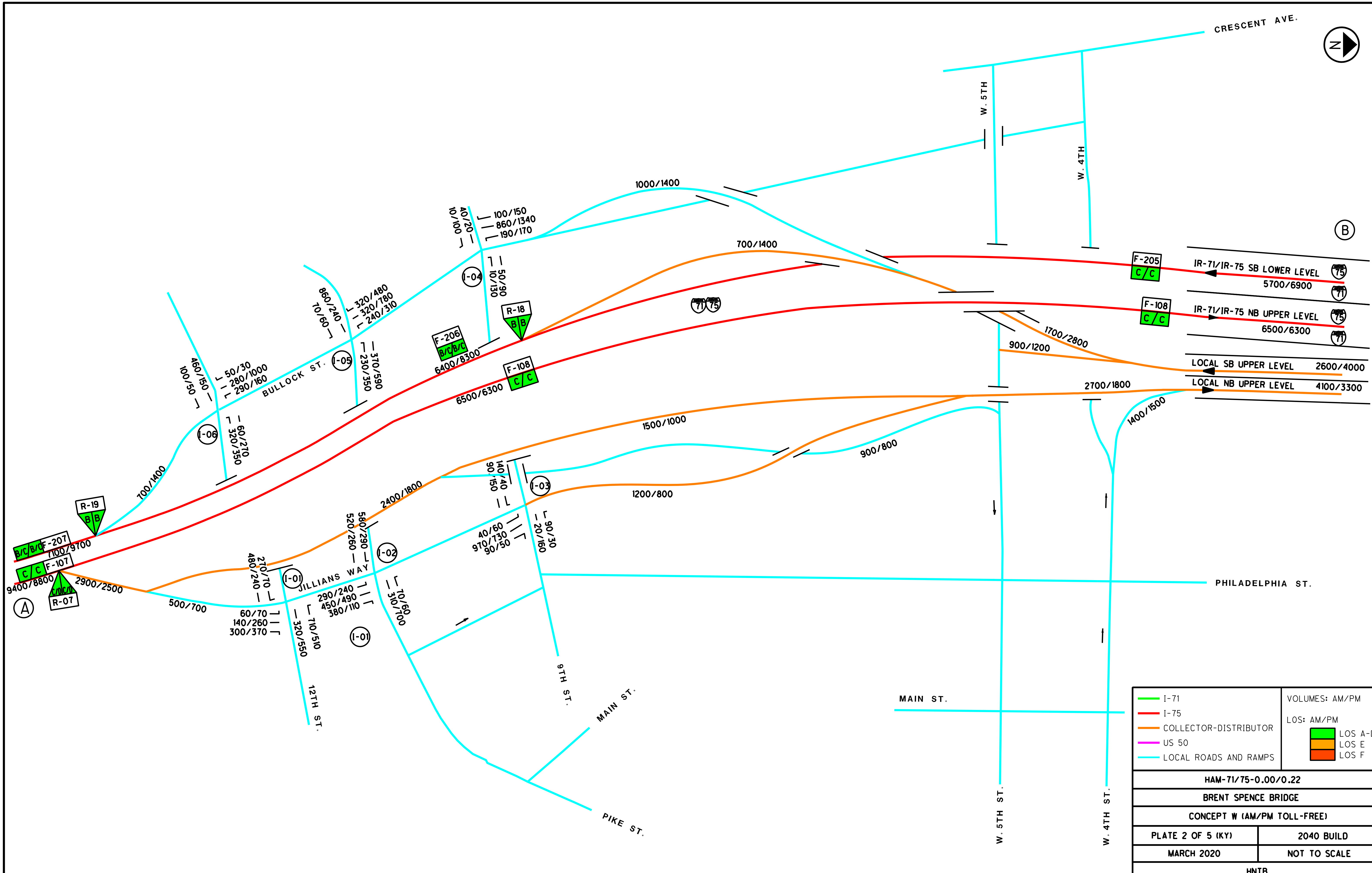
2040 Concept W Freeway Capacity Analysis Summary

I-75 Southbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
SB Mainline north of Western Hills Viaduct	F-201	Mainline	26.3	25.9 - 27	52	C/D	20.2	19.4 - 20.7	54	C/D
SB Entrance Ramp from Western Hills Viaduct	R-13	Merge[1]	23.5	22.5 - 24	--	C	18.3	17.5 - 18.7	--	C
SB Mainline south of Western Hills Viaduct	F-202	Mainline	23.6	23 - 24	52	C	18.8	17.9 - 19.3	53	C
SB Exit Ramp to Western Avenue	R-14	Diverge	22.7	21.5 - 24	--	C	17.8	17.1 - 18.6	--	C
SB Exit Ramp to I-75 Local	R-15	Diverge[1]	33.5	30.2 - 35.5	--	D/E	27.1	24.8 - 29.3	--	D/E
SB Mainline	F-203	Mainline	29.8	28.9 - 30.9	50	D	29.4	28 - 30.1	50	D
SB Exit to I-71 EB	R-16	Diverge[1]	25.3	23.9 - 26.6	--	C	24.4	23.2 - 25.6	--	C
SB Mainline	F-204	Mainline	19.5	18.3 - 20	52	C	20.3	19.4 - 21	51	C
SB Entrance Ramp from I-71 WB	R-17	Merge[1]	21.9	21.3 - 22.7	--	C	23.6	21.5 - 26.9	--	C
SB Mainline on New Bridge over Ohio River	F-205	Mainline	21.3	20.8 - 21.7	50	C	21.7	21.2 - 22	50	C
SB Entrance Ramp from Southbound I-75 Local	R-18	Merge[1]	16.5	15.9 - 17.2	--	B	18.3	17.7 - 19.3	--	B
SB Mainline	F-206	Mainline	18.6	17.9 - 19	55	B/C	20.6	20.2 - 20.9	54	B/C
SB Entrance Ramp from Bullock St	R-19	Merge[1]	14.5	14 - 14.8	--	B	18.7	18.2 - 19.3	--	B
SB Mainline	F-207	Mainline	17.9	17.6 - 18.4	64	B/C	21.2	20.5 - 21.7	63	B/C
SB Exit Ramp to Kyles/Dixie C-D Road	R-20	Diverge	16.4	15.9 - 17.1	--	B	21.1	20 - 21.7	--	B
SB Mainline (6 Lanes)	F-208	Mainline	13.2	12.8 - 13.8	65	B	16.8	16.3 - 17.1	63	B
SB Mainline (5 Lanes)	F-209	Mainline	15.5	14.5 - 16.4	63	B	21.7	21.4 - 22.1	59	B
SB Mainline (4 Lanes)	F-210	Mainline	19.4	19.1 - 19.7	62	C	26.6	26.2 - 27.2	60	C
SB Entrance Ramp from Kyles/Dixie C-D Road	R-21	Merge[1]	16.7	15.3 - 17.8	--	B	21.5	19.8 - 22.6	--	B
SB Entrance Ramp from Dixie Hwy	R-22	Merge	16.7	15.5 - 18.6	--	B	22.2	20.6 - 23.9	--	B
SB Mainline	F-211	Mainline	15.9	15.7 - 16	64	B	21.7	21.4 - 22	63	B
SB Exit Ramp to Buttermilk Pk.	R-23	Diverge	18.0	17 - 18.9	--	B	23.9	23.3 - 24.3	--	B
SB Mainline at Buttermilk Pk.	F-212	Mainline	18.2	16.9 - 18.7	64	B/C	25.3	24.5 - 26	63	B/C
Entrance from Buttermilk Pk.	R-24	Merge	18.2	16.4 - 19.2	--	B	24.0	23.1 - 26.1	--	B
SB Mainline	F-213	Mainline	17.2	17 - 17.5	62	B	24.6	23.8 - 25.4	57	B
SB Exit Ramp to I-275	R-24	Diverge	18.4	17.5 - 19.1	--	B	27.1	26.5 - 28.1	--	B
SB Mainline	F-214	Mainline	20.9	19.8 - 21.7	64	C	28.0	27.7 - 28.2	63	C

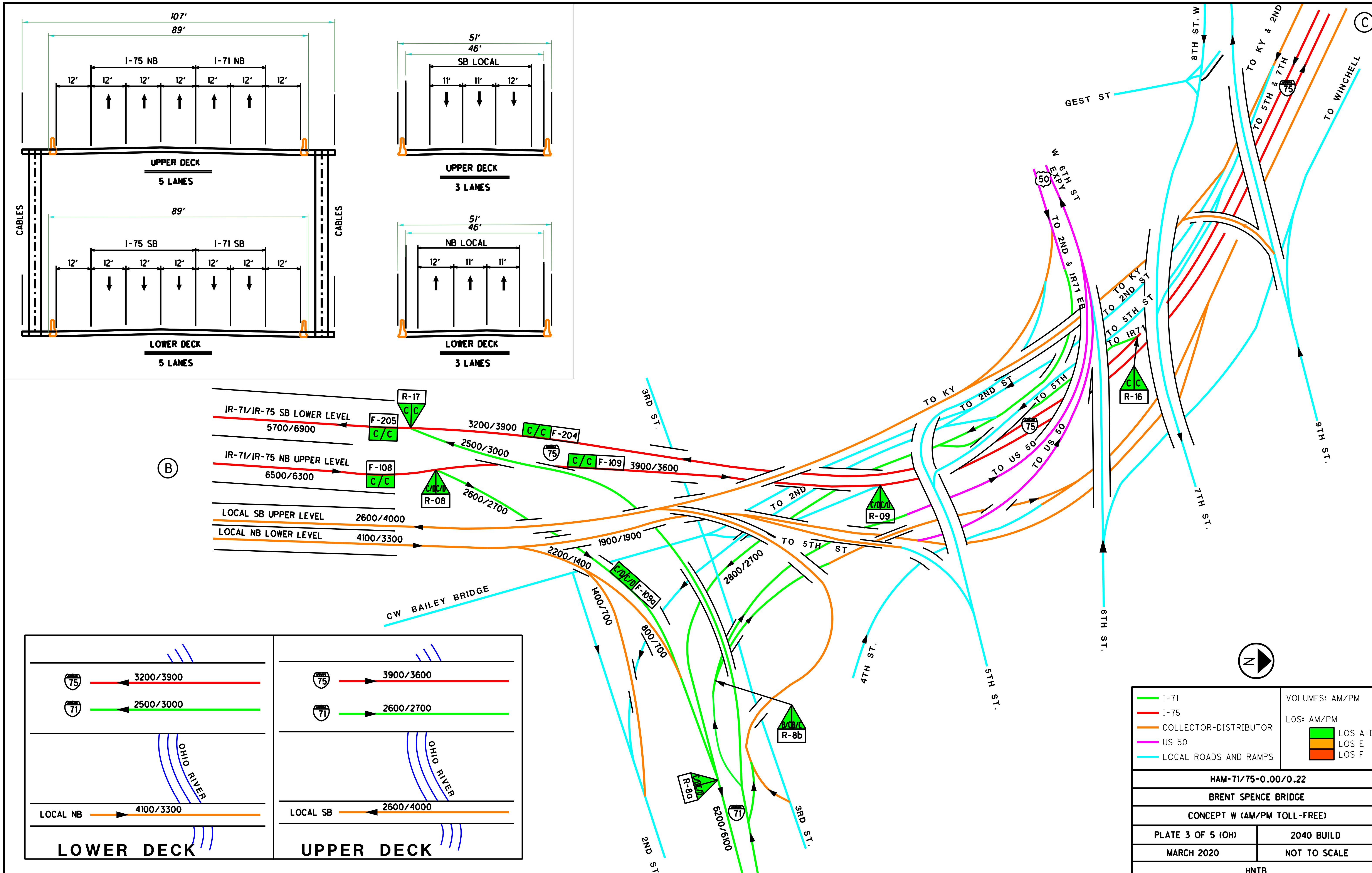


I-71 I-75 COLLECTOR-DISTRIBUTOR US 50 LOCAL ROADS AND RAMPS	VOLUMES: AM/PM LOS: AM/PM LOS A-D LOS E LOS F

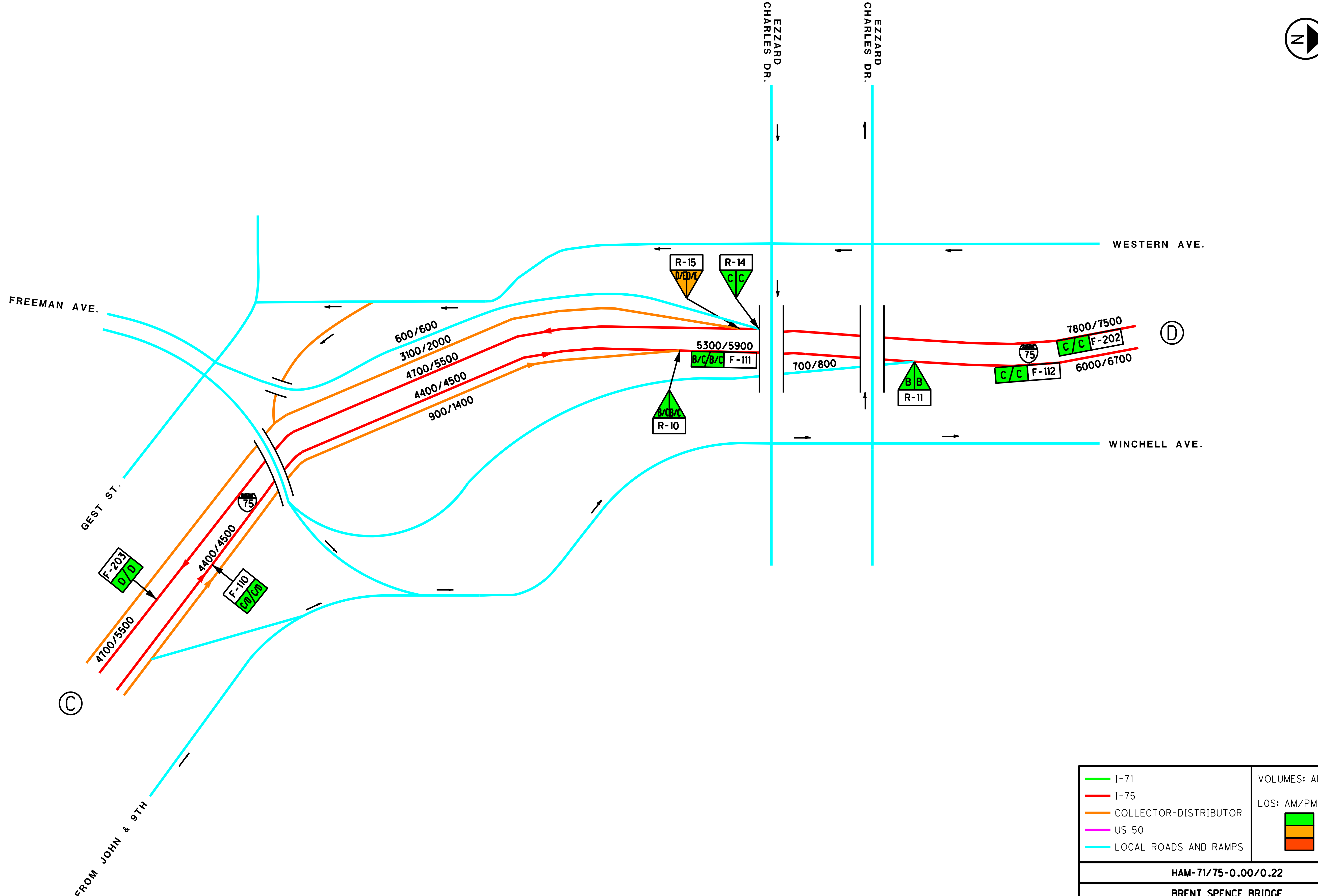
HAM-71/75-0.00/0.22	
BRENT SPENCE BRIDGE	
CONCEPT W (AM/PM TOLL-FREE)	
PLATE 1 OF 5 (KY)	2040 BUILD
MARCH 2020	NOT TO SCALE
HNTB	



CRESCENT AVE.
W. 5TH
W. 4TH
1000/1400
700/1400
100/150
860/1340
190/170
40/20
10/100
50/90
10/130
I-04
R-18
B B
F-206
B/C B/C
6400/8300
F-108
C C
6500/6300
320/480
320/780
240/310
860/240
70/60
370/590
230/350
I-05
BULLOCK ST.
50/30
280/1000
290/160
460/150
100/50
60/270
320/350
I-06
700/1400
R-19
B B
F-207
B/C B/C
7100/9700
F-107
C C
9400/8800
C/C C/C
R-07
2900/2500
A
500/700
270/70
480/240
I-01
JILLIANS WAY
290/240
450/490
380/110
60/70
140/260
300/370
320/550
710/510
12TH ST.
I-01
580/290
520/260
I-02
70/60
310/700
2400/1800
140/40
90/150
I-03
40/60
970/730
90/50
90/30
20/160
9TH ST.
MAIN ST.
PIKE ST.
1500/1000
1200/800
900/800
PHILADELPHIA ST.
F-205
C C
IR-71/IR-75 SB LOWER LEVEL
5700/6900
F-108
C C
IR-71/IR-75 NB UPPER LEVEL
6500/6300
71 75
1700/2800
900/1200
LOCAL SB UPPER LEVEL
2600/4000
LOCAL NB UPPER LEVEL
4100/3300
2700/1800
1400/1500
B
MAIN ST.
W. 5TH ST.
W. 4TH ST.
I-71
I-75
COLLECTOR-DISTRIBUTOR
US 50
LOCAL ROADS AND RAMPS
VOLUMES: AM/PM
LOS: AM/PM
LOS A-D
LOS E
LOS F
HAM-71/75-0.00/0.22
BRENT SPENCE BRIDGE
CONCEPT W (AM/PM TOLL-FREE)
PLATE 2 OF 5 (KY)
2040 BUILD
MARCH 2020
NOT TO SCALE
HNTB



HAM-71/75-0.00/0.22	
BRENT SPENCE BRIDGE	
CONCEPT W (AM/PM TOLL-FREE)	
PLATE 3 OF 5 (OH)	2040 BUILD
MARCH 2020	NOT TO SCALE
HNTB	



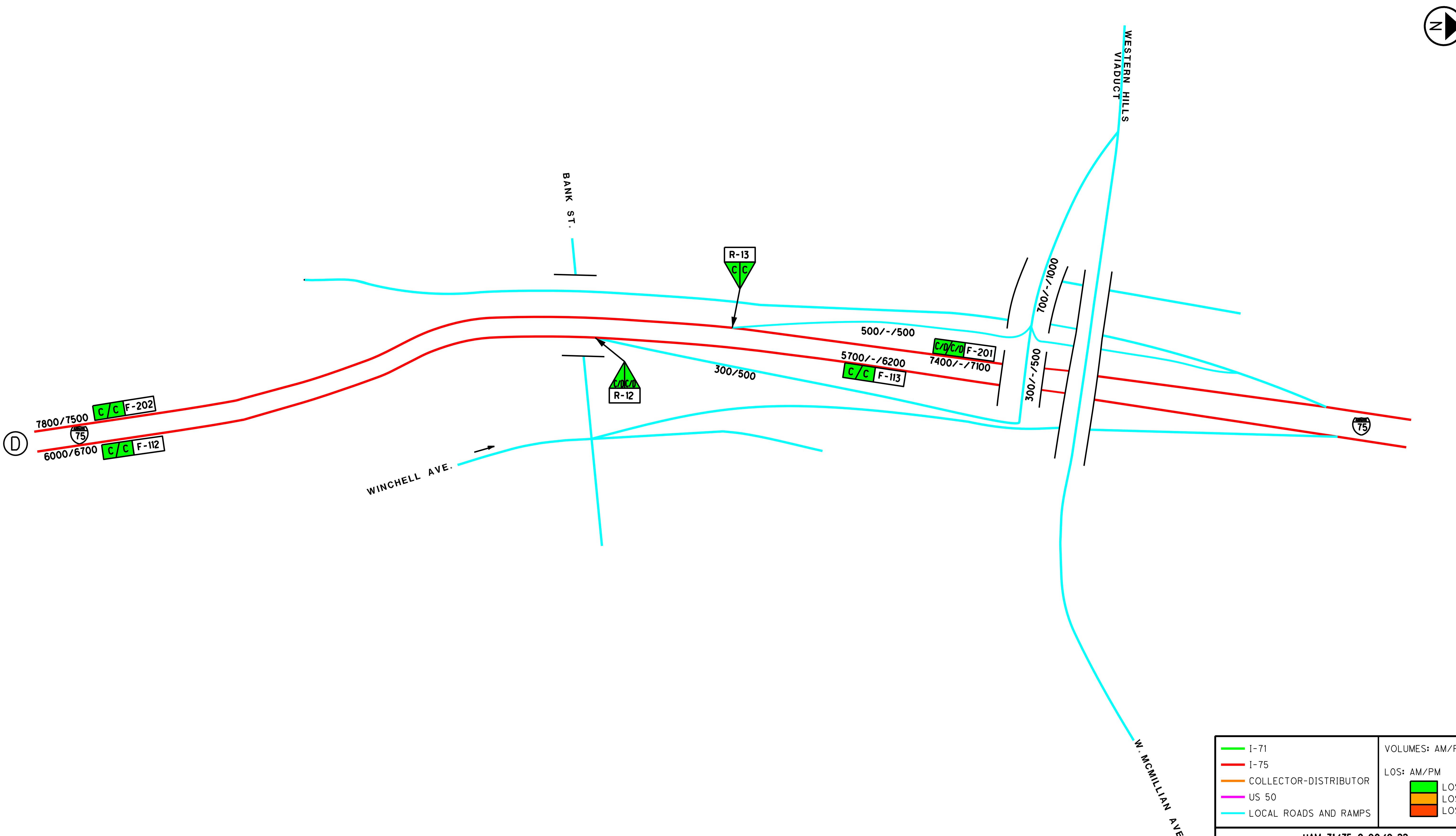
- I-71
- I-75
- COLLECTOR-DISTRIBUTOR
- US 50
- LOCAL ROADS AND RAMPS

VOLUMES: AM/PM

LOS: AM/PM

- LOS A-D
- LOS E
- LOS F

HAM-71/75-0.00/0.22	
BRENT SPENCE BRIDGE	
CONCEPT W (AM/PM TOLL-FREE)	
PLATE 4 OF 5 (OH)	2040 BUILD
MARCH 2020	NOT TO SCALE
HNTB	



I-71 I-75 COLLECTOR-DISTRIBUTOR US 50 LOCAL ROADS AND RAMPS	VOLUMES: AM/PM LOS: AM/PM LOS A-D LOS E LOS F

HAM-71/75-0.00/0.22	
BRENT SPENCE BRIDGE	
CONCEPT W (AM/PM TOLL-FREE)	
PLATE 5 OF 5 (OH)	2040 BUILD
MARCH 2020	NOT TO SCALE
HNTB	