t3

Vertical Constraints Analysis

APPENDIX T3 –

VERTICAL CONSTRAINTS ANALYSIS

Introduction

This memo describes the vertical constraints analysis conducted along the I-94 corridor between West Broadway St. in Minneapolis and US 61 in Saint Paul as part of Rethinking I-94.

The purpose of this analysis was to collect and review available data and documents specific to the I-94 overpass bridges and identify potential vertical constraints for future bridge or other freeway crossing projects such as lids. It is envisioned that this information will be useful as part of considering locations for crossing improvements in the Rethinking I-94 study area.

The analysis includes a list of the overpass bridges along with information on bridge vertical clearances, trench depth, frontage elevation, groundwater elevation, and known utilities at each bridge site. Each data set is described briefly below. Data is presented in the spreadsheet in Attachment 1.

NOTE: As indicated in Attachment 1, some data is missing or needs to be verified. As a result, summary statistics and conclusions below could change.

CROSSING IDENTIFIERS

This process started by reviewing the I-94 corridor and identifying all the bridges crossing over I-94. Then, data from MnDOT was added to identify bridge numbers and street crossings associated with each of the identified bridges. The analysis includes 59 bridge crossings, of which nine are identified as pedestrian crossings. Because the vertical constraints analysis is intended to be used for potential overcrossing improvements, streets crossing under I-94 or any of the accompanying ramps are not included.

VERTICAL CLEARANCE

Data was utilized to analyze vertical clearance for the existing overpass bridges and then compared with MnDOT bridge clearance guidelines. Per discussions with MnDOT, the desired vertical clearance for the overpass bridges is 16.5 feet for vehicular bridges (to accommodate over height/overweight vehicles), and 17.4 feet for pedestrian crossings. (The FHWA clearance requirement is 16.0 feet.)

The analysis shows most of the bridge crossings, including pedestrian bridges, are at least half a foot less than the desired vertical clearance. As indicated in the spreadsheet, clearance for most bridges differs from one end to the other. If either end of the bridge was less than the desired clearance for that bridge

type, it was flagged in the spreadsheet. A map of bridge vertical clearance compared to standards is provided in Attachment 2.

TRENCH DEPTH

The trench depth compares elevations at each end of the bridge crossings with the I-94 profile ground elevations. The trench depth varies based on the varying vertical profiles of both I-94 and the frontages, which may vary independently of each other. Per our findings, most of the bridges have a trench depth of 20 feet or greater, whereas 16 bridges have a trench depth less than 20 feet. For locations with trench depth less than 20 feet, adding a new crossing could create grade or issues at the bridge touchdown points due to the bridge being at a higher elevation than the frontage.

FRONTAGE ELEVATION

The frontage elevation information provides bridge elevations at the north and south end of each bridge location. Frontage elevation helps to identify major variances between each end of the bridge to indicate whether a new crossing might be constrained by a large elevation difference and resulting slope on the bridge. This could be of relevance to meeting ADA standards or for a freeway lid, could influence location, types of suitable uses, or design.

The frontage elevation analysis identified only six bridges with an elevation difference greater than 10 feet between the north and south side. Thus, it appears most of the bridge locations would not be constrained by frontage elevation differences.

GROUNDWATER

High groundwater elevations could be a constraint to future crossing projects, in particular if the freeway were to be lowered to accommodate needed vertical clearance. To assess this, we generated existing ground profiles for the I-94 corridor using the TIN surface file provided by MnDOT and also reviewed the *Metropolitan Council Metro Model (MM3)* which provides information on regional groundwater elevations. For the purposes of this analysis, we identified locations where groundwater was potentially within 10 feet of the roadway surface. As indicated in the spreadsheet, the groundwater elevation is only approximate. It is based on a model that indicates approximate regional groundwater elevations; local conditions can vary significantly. In addition, there may be smaller groundwater formations (e.g., perched aquifer) at higher elevations that could be encountered but which are not identified in the model. An example of this is at the TH 280 ramps to and from I-94 where groundwater seepage is evident but the modeled regional aquifer elevations are significantly lower.

The regional model data shows a majority of the I-94 corridor is above the regional groundwater level. Exceptions include bridge locations at Portland Ave. in Minneapolis, at several locations in downtown St. Paul (Wacouta St. N, 9th St E, 7th Street E.), and at US 52 just east of downtown St. Paul. At these locations, the estimated difference between the road surface and groundwater is less than 10 feet.

Given the approximate nature of the groundwater data, site specific investigation would be needed to understand actual groundwater issues.

UTILITIES

MnDOT also provided information on the existing utilities at the overpass bridges along the corridor. The utilities include stormwater, sanitary, water main, gas line, overhead power lines, buried power lines, fiber optics, telephone etc. The available MnDOT data only shows the horizontal location and does not provide vertical depths for the utilities. As a result, this data serves only as a potential indicator of potential utility conflicts. Vertical depth of the existing utilities would be needed to effectively identify potential utility conflicts.

DATA SOURCES & NOTES

Existing Bridge Clearance Data

1. MnDOT 2017 BRIM DATABASE,
2. Road and Bridge Plan and Construction Contracts (AS-BUILTS)
3. MnDOT Bridge Inspection and Structure Inventory Report (Trunk Highway Bridge Logs)

Note: 16.5 feet is required by MnDOT for overheight / overweight bridge clearance and 17.4 feet for pedestrian crossing bridges. FHWA minimum clearance for vehicular bridges is 16.0 feet.

Groundwater Elevation Data

1. Metropolitan Council METRO MODEL 3.

Utilities

1. MnDOT Utility CAD File

I-94 Profile Ground Line

1. MnDOT TIN Surface File

Prepared by: WSP, Community Design Group, and MnDOT

ATTACHMENT 1: VERTICAL CONSTRAINTS ANALYSIS TABLE

Rethinking I-94: Vertical Constraints Analysis

DATE: 05/09/2018

CROSSING IDENTIFIERS		VERTICAL CLEARANCE (FT)			TRENCH DEPTH (FT)			FRONTAGE ELEVATION (FT)			GROUNDWATER (FT)		UTILITIES						
		GREEN: Difference >= 0 Ft YELLOW: Difference = -0.1 to -0.5 Ft RED: Difference =< -0.5 FT			RED: Depth < 20 Ft			RED: Elevation difference <= 10 Ft			RED: Modeled Depth to Regional Groundwater <10 Ft		Vertical elevation of utilities must be examined separately					
STREET CROSSING	BRIDGE NUMBER	EXISTING CLEARANCE *	PROPOSED CLEARANCE **	CLEARANCE DIFFERENCE	I-94 PROFILE GROUND LINE	NORTH SIDE	SOUTH SIDE	NORTH SIDE	SOUTH SIDE	NORTH-SOUTH ELEVATION DIFFERENCE	MODELED REGIONAL GROUND WATER ELEVATION ***	MODELED DEPTH TO REGIONAL GROUNDWATER	KNOWN UTILITIES IN PLACE (empty cell = none known)						
													DRAINAGE	WATER	SANITARY	GAS	COMM.	POWER
W BROADWAY	27815	16.8	16.5	(+ 0.3)														
PLYMOUTH AVE N	27796	16.5	16.5	0														
EAST LYNDALE AVE N	27715	16.8	16.5	(+ 0.3)														
N 7TH ST	27782	16.6	16.5	(+ 0.1)														
OLSON MEMORIAL HWY (TH 55)	27785	16.1	16.5	(- 0.4)														
IRENE HIXON WHITNEY BRIDGE	27003	16.7	17.4	(- 0.7)														
GROVELAND AVE	27966	15.5 - 17.6	16.5	(- 1) - (+ 1.1)	864.3	20.50	32.23	884.80	896.53	11.7	819.0	45.3					X	X
LASALLE AVE	27836	15.4 - 18.5	16.5	(- 1.1) - (+ 2)	835.3	18.74	31.81	854.04	867.11	13.1	816.3	19.0	X				X	X
NICOLLET AVE	27837	15.4 - 16.8	16.5	(- 1.1) - (+ 0.3)	830.0	22.87	26.63	852.87	856.63	3.8	815.0	15.0	X				X	X
1ST AVE S	27838	14.8 - 17.4	16.5	(- 1.7) - (+ 0.9)	831.8	23.88	25.02	855.68	856.82	1.1	813.9	17.9	X		X		X	X
3RD AVE S	27V25	16.5 - 17.5	16.5	(0) - (+ 1)	832.6	22.49	23.94	855.09	856.54	1.4	810.4	22.2	X			X	X	X
TH 65 OVER I - 94	27843	15.0 - 15.8	16.5	(- 1.5) - (- 0.7)	820.1	35.52	36.95	855.62	857.05	1.4	806.8	13.3	X					X
PORTLAND AVE	27851	15.8 - 16.8	16.5	(- 0.7) - (+ 0.3)	810.9	40.69	42.76	851.59	853.66	2.1	804.7	6.2	X		X		X	X
PARK AVE	27852	15.4 - 16.5	16.5	(- 1.1) - 0	829.0	20.17	23.86	849.17	852.86	3.7	802.3	26.7	X		X		X	X
CHICAGO AVE	27853	14.7 - 15.1	16.5	(- 1.8) - (- 1.4)	830.7	16.10	18.07	846.80	848.77	2.0	799.3	31.4	X		X		X	X
11TH AVE	27854	14.7 - 14.8	16.5	(- 1.8) - (- 1.7)	829.0	16.31	17.81	845.31	846.81	1.5	792.2	36.8	X				X	
20TH AVE	27865	14.6 - 16.9	16.5	(- 1.9) - (+ 0.4)	824.8	16.49	15.76	841.29	840.56	-0.7	771.2	53.6	X				X	X
PED AT 22ND AVE	9892	14.4 - 14.9	17.4	(- 3.0) - (- 2.5)	831.2	7.65	8.74	838.85	839.94	1.1	764.0	67.2					X	X
25TH AVE	9420	14.8 - 15.1	16.5	(- 1.7) - (- 1.4)	818.3	20.11	19.95	838.41	838.25	-0.2	756.1	62.2	X				X	X
RIVERSIDE AVE	9421	14.8 - 16.2	16.5	(- 1.7) - (- 0.3)	814.7	23.71	23.55	838.41	838.25	-0.2	751.8	62.9	X				X	
E RIVER ROAD	27981	16.2 -18.4	16.5	(- 0.3) - (+ 1.9)	808.8	26.42	19.29	835.22	828.09	-7.1	730.4	78.4	X				X	
27TH AVE SE	27856	16.0 - 16.8	16.5	(- 0.5) - (+ 0.3)	802.8	26.21	17.73	829.01	820.53	-8.5	733.9	68.9	X				X	
FRANKLIN AVE SE	27957	18.8 - 19.6	16.5	(- 0.7) - (+ 3.1)	817.1	35.19	19.34	852.29	836.44	-15.8	740.2	76.9	X				X	
PED AT SEYMOUR	27958	16.8 - 21.0	17.4	(- 0.6) - (+3.6)	836.9	15.37		852.27			740.3	96.6					X	X
I-94 over EB to NB & SB to WB Ramps	62812	15.3	16.5	(-1.2)	855.0						760.0	95.0					X	X
I-94 over SB to EB Ramp	62808	14.3 - 14.9	16.5	(- 2.2) - (- 1.6)	848.0						764.3	83.7						
CP RAIL OVER I - 94	62814	16.0 - 16.4	16.5	(- 0.5) - (- 0.1)	846.2	25.83	21.42	872.03	867.62	-4.4	763.8	82.4						
PELHAM BLVD	62813	39.9	16.5	(+ 23.4)	846.0	42.58	50.07	888.58	896.07	7.5	764.4	81.6					X	X
CRETIN AVE	9452	14.9 - 17.8	16.5	(- 1.6) - (+ 1.3)	887.8	30.19	18.6	917.99	906.40	-11.6	774.7	113.1						X
CLEVELAND AVE	9457	14.8 - 15.6	16.5	(- 1.7) - (- 0.9)	883.7	19.65	16.2	903.35	899.90	-3.5	780.3	103.4					X	
PRIOR AVE	62845	14.8 - 17.1	16.5	(- 1.7) - (+ 0.6)	880.9	16.25	26.58	897.15	907.48	10.3	784.4	96.5					X	X
PED AT ALDINE	62849	16.0	17.4	(-1.4)	912.2	8.47	9.79	920.67	921.99	1.3	792.3	119.9					X	X
SNELLING AVE	9377	15.4	16.5	(- 1.1)	907.4	19.58	18.64	926.98	926.04	-0.9	794.4	113.0					X	X
PASCAL AVE	9379	14.9 - 15.6	16.5	(- 1.6) - (- 0.9)	900.0	23.66	19.7	923.66	919.70	-4.0	796.7	103.3					X	X
HAMLINE AVE	9381	14.9 - 15.8	16.5	(- 1.6) - (- 0.7)	904.2	24.12	20.12	928.32	924.32	-4.0	798.9	105.3					X	X
PED AT GRIGGS	62809	18.2 - 18.8	17.4	(+ 0.8) - (+ 1.4)	909.3	22.91	23.25	932.21	932.55	0.3	800.4	108.9				X	X	X
LEXINGTON AVE	9383	15.7 - 17.1	16.5	(- 0.8) - (+ 0.6)	875.0	17.39	24.09	892.39	899.09	6.7	800.4	74.6					X	X
PED AT CHATSWORTH ST	62867	17.1 -17.5	17.4	(- 0.3) - (+ 0.1)	871.0	17.81	20.06	888.81	891.06	2.3	800.4	70.6	X		X		X	X
N VICTORIA ST	9663	15.1 - 15.6	16.5	(- 1.4) - (- 0.9)	866.0	20.20	22.63	886.20	888.63	2.4	800.4	65.6					X	X
PED AT GROTTO ST	62800	17.2	17.4	(-0.2)	884.3	14.69	20.6	898.99	904.90	5.9	800.4	83.9					X	X
DALE ST N	9387	15.2 - 15.4	16.5	(- 1.3) - (- 1.1)	904.8	20.12	22.48	924.92	927.28	2.4	795.9	108.9					X	X
PED AT MACKUBIN ST	62892	16.7	17.4	(-0.7)	885.0	5.23	10.65	890.23	895.65	5.4	789.9	95.1					X	X
WESTERN AVE N	62877	16.2	16.5	(- 0.3)	856.9	19.25	26.59	876.15	883.49	7.3	783.9	73.0					X	X
MARION ST N	62878	16.2	16.5	(- 0.3)	837.0	18.55	29.19	855.55	866.19	10.6	774.0	63.0					X	X
JOHN IRELAND BLVD	9632	15.5 - 16.2	16.5	(-1) - (- 0.3)	827.1	24.10	22.79	851.20	849.89	-1.3	770.5	56.6					X	X
ST PETER S	62897	16.4	16.5	(- 0.1)	788.5	44.99	21.5	833.49	810.00	-23.5	754.8	33.7						X
WABASHA ST N	62888	16.4	16.5	(- 0.1)	779.9	29.00	23.35	808.90	803.25	-5.6	754.2	25.7			X			
CEDAR ST	62889	16.4	16.5	(- 0.1)	778.7	24.32	22.31	803.02	801.01	-2.0	753.6	25.1						
MINNESOTA ST N	62891	16.8	16.5	(+ 0.3)	775.0	22.45	22.45	797.45	797.45	0.0	752.9	22.1						
ROBERT ST N	62894	16.6	16.5	(+ 0.1)	770.2	23.17	25.1	793.37	795.30	1.9	752.2	18.0						
JACKSON ST	62893	16.3	16.5	(- 0.2)	763.9	24.96	23.16	788.86	787.06	-1.8	751.3	12.6						
WACOUTA ST N	62701	16.7	16.5	(+ 0.2)	747.7	21.21	22.67	768.91	770.37	1.5	749.8	-2.1	X		X		X	X
9TH ST E	62702	16.2	16.5	(- 0.3)	744.0	20.80	20.64	764.80	764.64	-0.2	745.9	-1.9	X	X			X	X
7TH ST E	62703	16.3	16.5	(- 0.2)	740.6	23.05	23.29	763.65	763.89	0.2	737.9	2.7	X	X	X		X	X
US 52	62881	16.3	16.5	(- 0.2)	735.3						737.3	-2.0	X				X	
KELLOGG BLVD	62080A	17.8 - 20.1	16.5	(+ 1.3) - (+ 3.6)									X		X		X	X
MOUNDS BLVD	62706	16.3 -20.3	16.5	(- 0.2) - (+ 3.8)									X		X			X
PED AT MAPLE ST	62868	16.0	17.4	(-1.4)													X	X
EARL ST	62861	15.6 - 16.4	16.5	(- 0.9) - (- 0.1)													X	X

DATA SOURCES & NOTES

* Existing bridge clearance data is from MnDOT 2017 BRIM DATABASE, Road and Bridge Plan and Construction Contracts (AS-BUILTS) & MnDOT Bridge Inspection and Structure Inventory Report (Trunk Highway Bridge Logs)
** For vehicle bridges, 16.5 feet is required by MnDOT for overheight/overweight bridge clearance. FHWA minimum clearance is 16.0 feet. For pedestrian bridges, the minimum clearance is 17.4 feet.
*** Groundwater elevation extracted from Metropolitan Council METRO MODEL 3. Localized conditions may be different.
**** Groundwater Elevation extracted from Piezometer reading by MnDOT

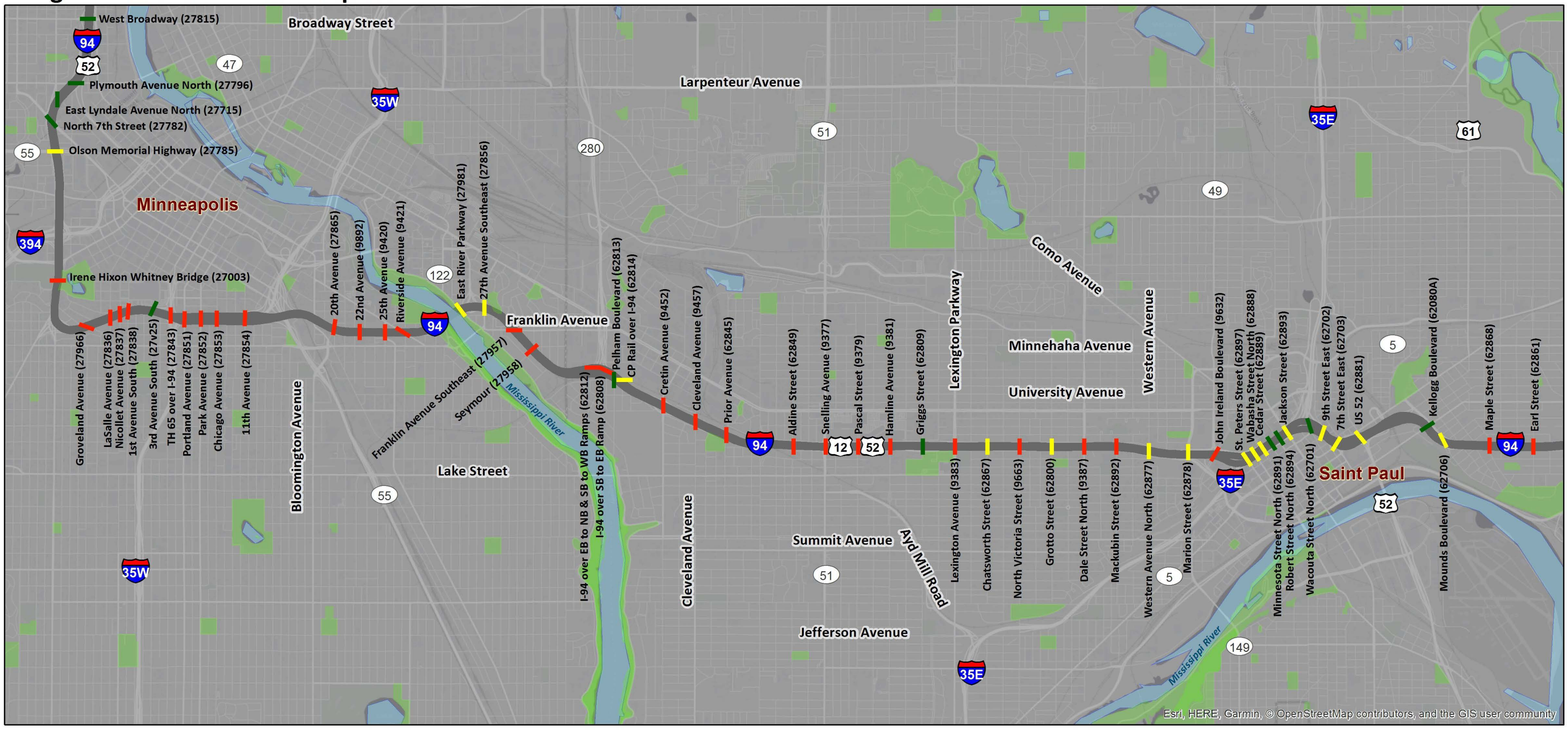
UTILITY DEFINITIONS

Drainage: Storm pipes, Manholes, Catch Basins
Water: Water Pipes, Valves, Hydrants
Sanitary: Sanitary pipes, Manholes
Gas: Gas Line
Communication: Buried Fiber Optics Line, Buried Telephone Line
Power: Buried Signal Line, Buried Power Line, Overhead Power Line

Orange - Missing TIN file from W. Broadway to Oak Grove/ Vineland and Lafayette Bridge to Johnson Parkway
Light Green- Missing Utility information from W. Broadway to East end of Lowry Tunnel
Dark Blue - MnDOT to verify bridge location/identifiers/elevation information

ATTACHMENT 2: BRIDGE VERTICAL CLEARANCE COMPARED TO STANDARDS

Bridge Vertical Clearance Compared to Standards



Legend

Difference Compared to Standards

- >= 0 Ft
- -0.1 to -0.5 Ft
- <= -0.5 Ft

1 inch = 0.75 miles

0 0.375 0.75 1.5 Miles

Assumes: 16.5' standard for vehicular bridges
17.4' standard for pedestrian bridges

DEPARTMENT OF TRANSPORTATION

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