US-95 Kootenai County Corridor Study

Special Issue

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Introduction

The U.S. Highway 95 (US-95) Kootenai County Corridor Study [Idaho Transportation Department [ITD] project No. A11(223); ITD project key #11223] will evaluate the historic, existing and future conditions of the US-95 highway from milepost 398.055 to milepost 451.135. As part of the project, a comparative analysis of adjacent projects within the corridor will also be conducted to help identify the performance and benefits achieved from past improvements. The study will also review and update components of the previous corridor study (Project No. NH-5110(126), Key No. 07039) that was conducted in 2000/2001 for this segment of US-95.

The US-95 Kootenai County corridor study will allow ITD to plan the US-95 corridor in a collaborative manner that involves local citizens, stakeholders, and agencies that are influenced by the corridor. The planning process for the corridor will identify strategies, actions, and goals for the management and improvement of the US-95 highway corridor. Coordinating adjacent and concurrent transportation plans will help to produce a corridor blueprint that successfully outlines corresponding regional needs and benefits.

PURPOSE OF REPORT

The Special Issue report examines two segments from the 2003 US-95 Coeur d'Alene Corridor Study. The Spokane River Crossing Segment runs from Upriver Drive (milepost 428.6) to the Spokane River Bridge (milepost 429.6), and the Ironwood Segment runs from the Spokane River Bridge to Ironwood Drive (milepost 430.3). The 2003 study was reviewed, and several of its recommendations were evaluated with current traffic projections.

The existing condition of the two segments was studied to establish a basis for traffic safety, growth projections, and operational performance. Projected traffic volumes were provided by the Kootenai Metropolitan Planning Organization (KMPO) and are shown in Appendix A. Using these traffic projections, the future operational performance was analyzed to identify expected operational deficiencies. In locations projected to be operationally deficient, various scenarios were developed and analyzed in order to form recommendations for each area.

THE PUBLIC PROCESS

The public involvement process for the project included meetings with key stakeholders and one public meeting. Initial stakeholder meetings took place with the City of Coeur d'Alene, Coeur d'Alene Casino, Worley Fire District, and the Coeur d'Alene Tribe Public Works Department. These meetings provided insight and coordination for specific improvements identified by agencies and businesses along the corridor. Before the plan is finalized, it will be available for public review and comment on ITD's website.

Eleven people attended the public meeting on June 25, 2013. Attendees were introduced to the project planning process, and were able to review and comment on project information including an initial list of "hot spot" improvement projects. Using the compiled comments that were received from the public meeting, the initial "hot spot" project list was further evaluated. This list of projects will be prioritized for future funding opportunities. Additional information on the project prioritization process was provided in the Existing Conditions Report.

Review of 2003 Corridor Study

Previously, the 2003 US-95 Coeur d'Alene Corridor Study considered two portions of US-95 that this Special Issue will update based on existing conditions and the most recent traffic projections. Not all options will be assessed in this report, but is still useful to summarize all the options that were previously considered.

The Spokane River Crossing Segment extends from Upriver Drive to the east abutment of the Spokane River Bridge. The segment is primarily rural in nature but has a relatively high density of intersections. Adjacent to this, the Ironwood Segment is an urbanized segment of US-95 from the Spokane River to Ironwood Drive. The 2003 study also included the I-90 interchange, which is outside of the scope of this study.

SPOKANE RIVER CROSSING SEGMENT

The 2003 study indicated that the current two-lane configuration will be insufficient for projected traffic volumes on the Spokane River Crossing Segment. To avoid widening the highway, future volumes could be significantly lowered with the construction of the Huetter Alternate Route; however, this option was later abandoned in the 2009 Huetter Corridor Study.

Community input for this segment included environmental, safety, access, and multimodal concerns. A proposed alternate route would impede a conservation easement, and so a second alternate route was developed. There were concerns about speeds on US-95 south of the Spokane River, as well as safety regarding boat ramp access at Blackwell Island. Possible solutions included additional enforcement, advanced warning signs, flashing beacons, and traffic signals. Stakeholders expressed a need for access improvements at Blackwell Island, Millview Lane (i.e., Fairmont Loop), and Upriver Drive, as well as a need for a multi-use path from the Centennial Trail to Cougar Bay. There was also a desire to improve the natural and aesthetic appeal between the Spokane River and the nature preserve.

Refined Options

Refined options included in the 2003 study were developed to address the projected traffic demand as well as community input. This report will assess these options, which include the following:

- Widen and possibly replace the US-95 Spokane River Bridge.
- Raise and widen US-95 on Blackwell Island to 4 lanes.
- Construct a Millview Lane connection route, including a new bridge.
- Construct an interchange at Millview Lane / Marine Drive with on/off ramps and an undercrossing.
- Replace the existing slough bridge on US-95 with a 4-lane bridge.
- Connect Upriver Drive to Millview Lane to eliminate the Upriver Drive intersection on US-95.
- Construct a Blackwell Road connection under US-95.

IRONWOOD SEGMENT

The Ironwood Segment contains the Walnut Avenue intersection, a three-way stop-controlled intersection where US-95 takes a 90-degree turn onto Lincoln Way. The segment also includes the signalized Ironwood intersection and a number of side streets and driveways.

Walnut Avenue Intersection

Each option in the 2003 study involves realigning US-95 to the northwest. This allows for a 35-mph curve to maintain the flow of traffic along US-95. The realigned portion would be a four-lane facility. Each of the following options is illustrated in Figure 1 as reproduced from the 2003 study:

- ***At Grade Intersection*** – This option is similar to Alternative 2 from the 1995 study but instead using a four-lane facility.
- ***Harrison Avenue Partial Cloverleaf Interchange*** – Realign Harrison Avenue to pass over or under US-95 and terminate at Northwest Boulevard. This would include an intersection between Lincoln Way and Harrison Avenue south of US-95, and C Street would be realigned to meet at this intersection. Walnut Avenue would be converted to a cul-de-sac west of C Street. The partial cloverleaf interchange would provide a cloverleaf off ramp for northbound US-95. The other on and off ramps would match those of a diamond interchange.
- ***Harrison Avenue Diamond Interchange*** – This would be a full diamond interchange with the same realignments used in the partial cloverleaf interchange.
- ***Partial interchange at Walnut/Lincoln*** – This option is similar to Alternative 1 from the 1995 study, but without the southbound through restriction. Northbound and southbound directions on US-95 would be divided, allowing southbound Lincoln Way to pass under US-95. Harrison Avenue would not be realigned; instead a four-leg intersection would be created between Lincoln Way and Harrison Avenue. This intersection would include an off ramp coming from northbound US-95.
- ***Harrison Avenue Diamond Interchange and US-95 Viaduct*** – This option combines the diamond interchange with a mainline viaduct or expressway plan. The viaduct could include frontage roads that tie in to the northbound on ramp and southbound off ramp.

Prelude: 1995 Study of the Walnut Ave. Intersection

Prior to the 2003 study, a 1995 study considered the intersection of US-95 with Walnut Avenue and Lincoln Way. The three alternatives below are a precursor to the options presented in the 2003 study.

Alternative 1

Bypass the intersection on a two-lane curve. A four-leg intersection at Lincoln Way and Walnut Avenue would be stop controlled. This alternative removes southbound access to Lincoln Way and Walnut Avenue.

Alternative 2

Realign the highway to curve around to Lincoln Way. Include a T-intersection for the south leg of Lincoln Way, with a stop sign for Lincoln Way only. Walnut Avenue would intersect with Lincoln Way just south of US-95.

Alternative 3

Signalize the intersection utilizing the most of the existing pavement area. The southbound right turn would remain as is with a yield sign.

Not all options will be assessed, but only what is considered most relevant. Of the above options, the two that will be assessed are the at-grade intersection and the Harrison Avenue diamond interchange. Several new options will also be considered.

Access Management

Two alternatives were presented in the 2003 study to manage access along the Ironwood Segment. An expressway option would eliminate the existing direct access to driveways and side streets, providing access instead through frontage roads. While an expressway

would serve traffic extremely well, less costly options were shown to be adequate for projected traffic volumes.

A less expensive access management option would be to eliminate left turns from minor streets by constructing channelization devices. The channelization would allow for left turns from US-95 onto minor streets as well as U-turns on US-95. Some locations, such as Lacrosse and Emma Avenues, cannot accommodate this channelization within the existing right-of-way.

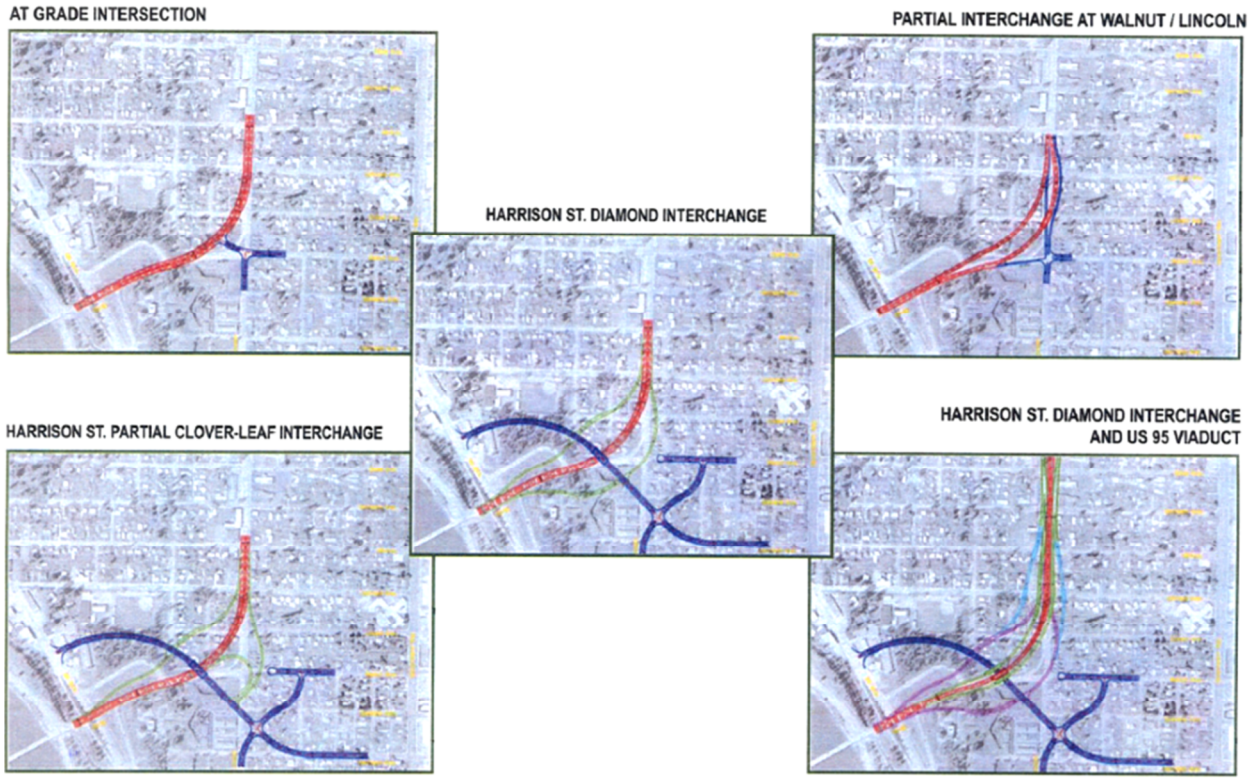


Figure 1. Walnut Avenue Intersection Options (Source: 2003 US-95 Coeur d'Alene Corridor Study)

Refined Options

The refined options included in the 2003 Corridor Study for the Ironwood Segment highlight the fundamental recommendations for the segment as follows:

- US-95 would be widened to 4 lanes from the Spokane River through Linden Avenue. (It is already 5 lanes north of Linden Avenue.)
- The existing intersection at US-95 / Walnut Avenue / Lincoln Way would be eliminated in favor of a signalized intersection with Harrison Avenue. A 90-degree bend would connect Walnut Avenue to Lincoln Way, with a new signal at Harrison Avenue / Lincoln Way. The signalized intersection option for US-95 / Harrison Avenue was recommended because it would adequately serve projected 2020 traffic volumes at a much lower cost than the other options.
- A new signal would be installed at Northwest Boulevard / Harrison Avenue due to the extension of Harrison Avenue.
- Linden Avenue would be closed to US-95 access.
- Left-turn channelization would be installed at Lacrosse Avenue. Left-turn / U-turn channelization would be installed at Mill Avenue (southbound only) and Emma

Avenue. At all other locations, left turns would be prohibited by the installation of median curbing. Right-turn access would be permitted at local businesses.
- Ironwood Drive could be widened to accommodate dual left turn lanes onto US-95.
- Ironwood Drive would be extended to 4th Street.

Most of these refined options will be evaluated, with a few exceptions. The Northwest Boulevard / Harrison Avenue signal will not be assessed, as it does not fit within this study's preferred alternative. Widening of Ironwood Drive was considered outside of the scope of this study, as was the extension of Ironwood Drive to 4th Street.

Existing Conditions

The existing conditions that were considered on the two segments include traffic volumes, crash history, bridge ratings, and performance measures. Historical traffic data indicated the historical growth rate and monthly traffic variation, which were useful in interpreting recent turning movement counts. Crash history compares the segments with similar roads across the state as one means of identifying safety concerns. The condition of bridges informs decision making on possible widening or realignment. Finally, delay and LOS describe the performance of each segment.

SPOKANE RIVER CROSSING SEGMENT

Traffic Volumes

Traffic volumes on the Spokane River Crossing Segment have grown an average of 1% to 2% annually between 1996 and 2011, as seen in Figure 2. Annual growth was computed exponentially throughout this time period. A sharp growth between 2010 and 2011 contributed substantially to the average.

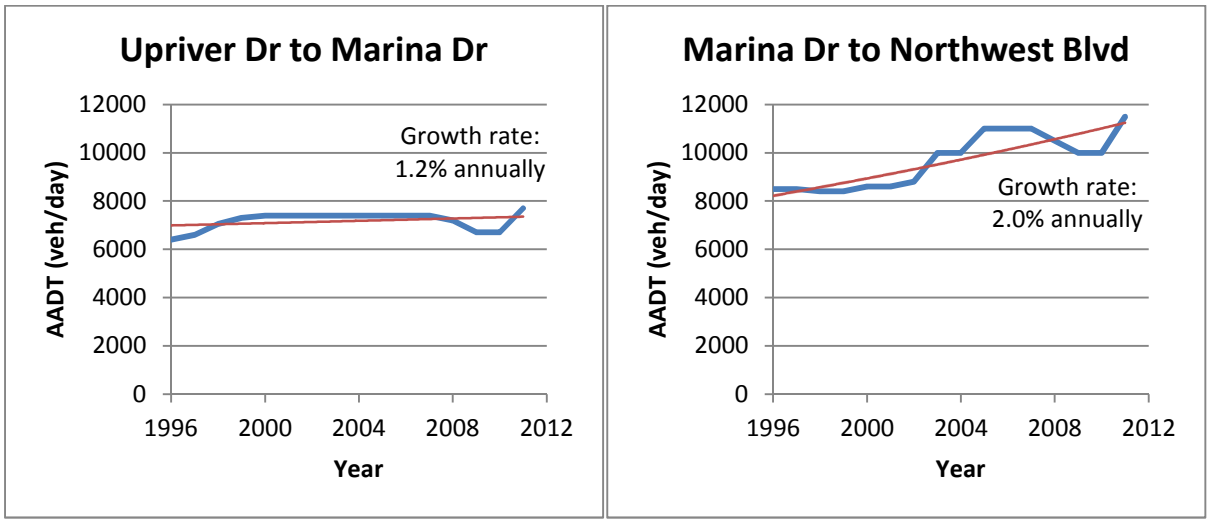


Figure 2. Spokane River Crossing Segment AADT Growth from 1996 – 2011

Seasonal traffic variation data was gathered from a traffic counter at US-95 and Haycraft Avenue in Coeur d'Alene. While the volumes at Haycraft Avenue are much higher than on the Spokane River Crossing Segment, it is assumed that variations between the two sites are proportional. Monthly traffic volumes were averaged between 1996 and 2011, and then were compared with the average yearly volume over the same period. This provided the proportion of traffic that falls in each month throughout the year, as shown in Figure 3.

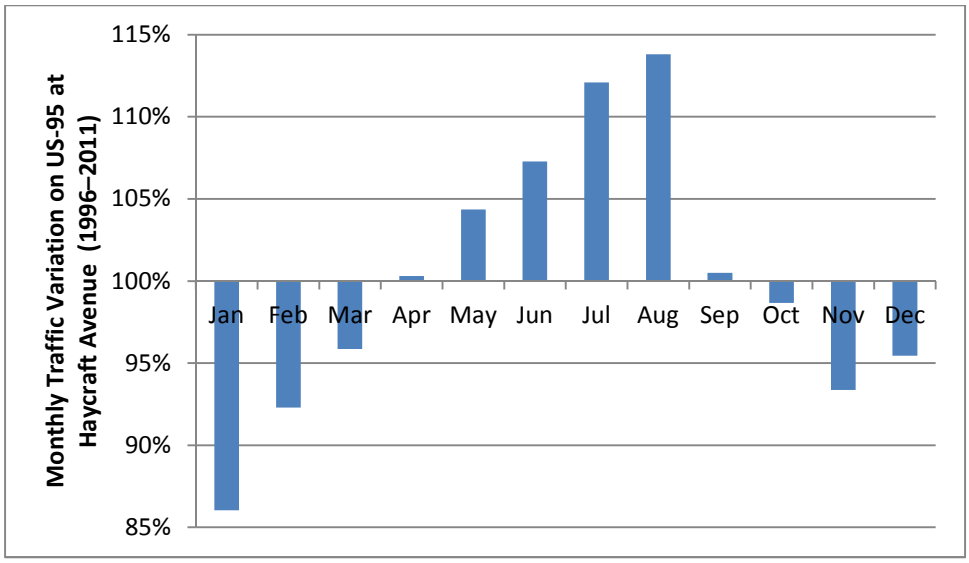


Figure 3. Monthly Traffic Variation, Averaged from 1996 – 2011

Turning movement counts were taken at Upriver Drive, Blackwell Mill Road, and Fairmont Loop in February 2013. These counts were seasonally adjusted by a factor of 1.23 based on the traffic counter data at Haycraft Avenue. The seasonally adjusted counts in Table 1 were used to analyze the existing operational performance of these intersections.

Table 1. Seasonally Adjusted Turning Movement Counts on the Spokane River Crossing Segment

Intersection	US 95						Minor Street	
	NBL	NBT	NBR	SBL	SBT	SBR	Left	Right
AM Volumes								
Upriver Drive	0	439	-	-	266	20	109	1
Blackwell Mill Road	*(No AM traffic counts)*							
Fairmont Loop	0	550	-	-	289	15	39	5
PM Volumes								
Upriver Drive	7	433	-	-	460	89	48	4
Blackwell Mill Road	-	549	0	10	573	-	10	2
Fairmont Loop	4	486	-	-	549	33	22	4

Crash History

From Upriver Drive to Marina Drive (MP 428.6 to 429.2), there were 19 crashes between 2007 and 2011. Of these, 6 were injury crashes, and none were fatal. At an AADT of approximately 7,100 during those 5 years, this translates to an average of 80 injury crashes per 100 million annual vehicle miles traveled (AVMT). This is slightly more than double the statewide injury crash rate in rural areas from 2007 to 2011, which averaged 34 injury crashes per 100 million AVMT according to ITD's *Idaho Traffic Crashes 2011*. Between Marina Drive and the east end of the Spokane River Bridge (MP 429.3 to 429.5), where the AADT is higher, there were 2 crashes, both without injury.

Of the 21 crashes on the Spokane River Crossing Segment from 2007 to 2011, 4 were reported as intersection related and 1 more was driveway related. There were also 6 crashes in the vicinity of Upriver Drive; these may have been intersection related but were not reported as such.

Bridge Rating

Two bridges exist on the Spokane River Crossing Segment, and both have a sufficiency rating of Fair (between 50 and 80). They are both two-lane structures built in the late 1960s. Table 2 summarizes these bridges.

Table 2. Bridge Information on the Spokane River Crossing Segment

Milepost	Bridge No.	Bridge Location	Length (ft)	Year Built	Sufficiency Rating
429.00	18675	Blackwell Slough	37.2	1969	75.4
429.42	18680	Spokane River; BNRR & UPRR	310.6	1968	64.1

Performance Measures

Turning movement counts were conducted at Upriver Drive, Blackwell Mill Road, and Fairmont Loop. Since these counts were performed in February 2013, a factor was applied to scale the volumes up to summer peak. A factor of 1.23 was applied to reflect the difference between February and August volumes measured at Haycraft Avenue.

Highway Capacity Software 2010 (HCS 2010), which is based on the Highway Capacity Manual 2010 (HCM 2010), was used to analyze intersection performance during the AM and PM peak hours. As can be seen in Table 3, the minor street LOS was C at all intersections except in the PM peak at Blackwell Mill Road.

The segment itself currently operates at LOS E. Segment LOS is governed by percent time spent following, estimated here at 81%. Even though the LOS is poor, however, the roadway operates at only 44% of its estimated capacity. The existing PM peak-hour volume is 1046 veh/hr for both directions combined, which means the segment would not be at capacity until the combined directional volume reaches 2800 veh/hr.

Table 3. Spokane River Crossing Existing Intersection Performance

Intersection	Minor Street			Major Street Left Turn		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
AM Volumes						
Upriver Drive	0.33	20	C	*(No left turn volume)*		
Blackwell Mill Road	*(No AM traffic counts)*					
Fairmont Loop	0.16	20	C	*(No left turn volume)*		
PM Volumes						
Upriver Drive	0.17	19	C	0.01	9	A
Blackwell Mill Road	0.03	13	B	0.01	9	A
Fairmont Loop	0.11	23	C	0.01	9	A

IRONWOOD SEGMENT

Traffic Volumes

From 1996 to 2011, traffic growth was around 1% annually on the Ironwood Segment, as seen in Figure 4. A sharp increase between 2010 and 2011 contributed substantially to the average growth north of Walnut Avenue.

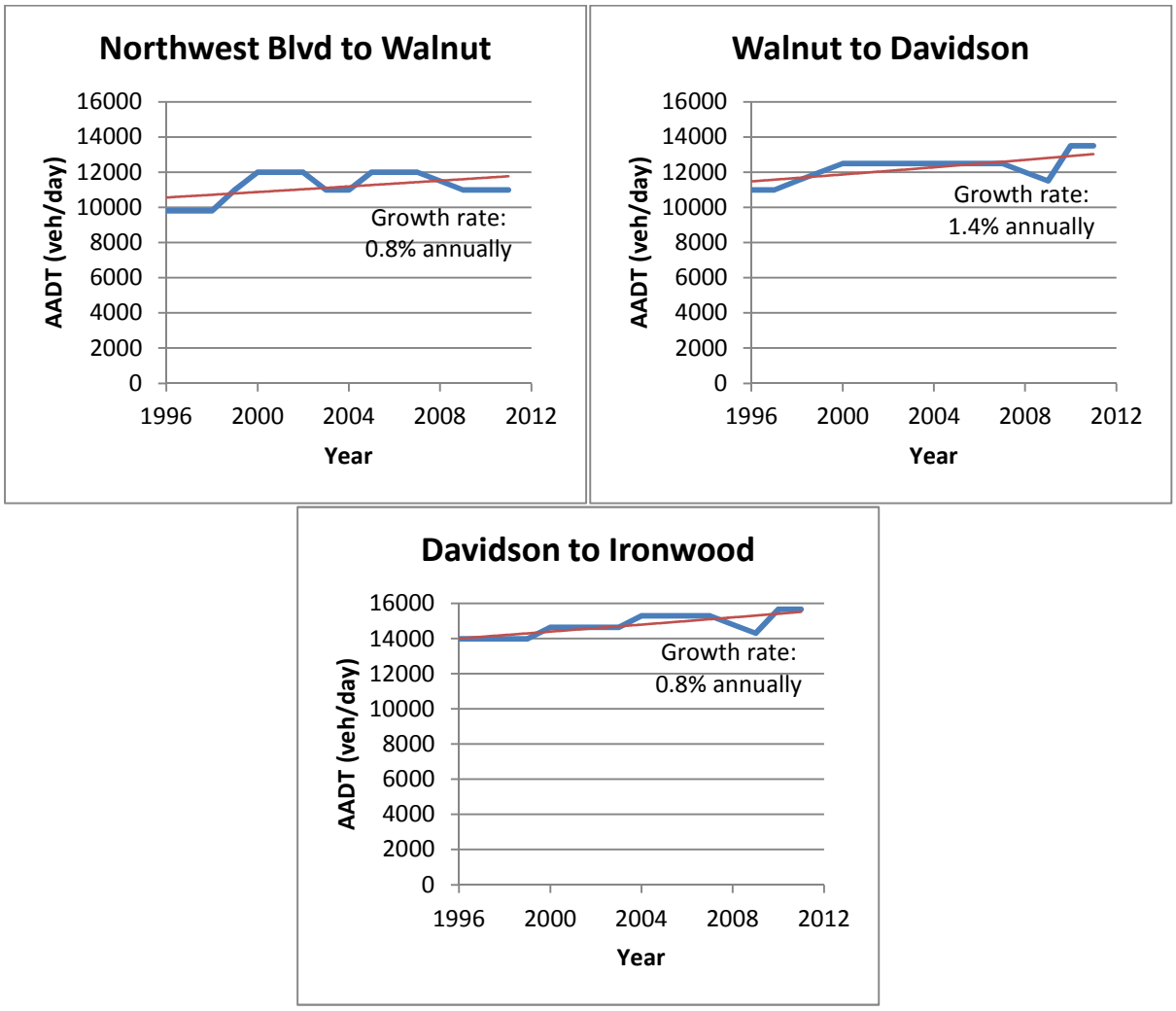


Figure 4. Ironwood Segment AADT growth from 1996 to 2011

In February 2013, turning movement counts were conducted at the intersection of US-95 with Lincoln Way and Walnut Avenue. These counts were seasonally adjusted by a factor of 1.23 based on the traffic counter data at Haycraft Avenue. Table 4 shows the seasonally adjusted counts that were used in analyzing the existing intersection performance.

Table 4. Seasonally Adjusted Turning Movement Counts at US-95 / Lincoln Way / Walnut Ave

Time of Day	US 95						Lincoln Way			Walnut Avenue		
	SBL	SBT	SBR	EBL	EBT	EBR	NBL	NBT	NBR	WBL	WBT	WBR
AM Peak Hour	21	148	317	269	96	23	30	113	6	0	52	16
PM Peak Hour	27	126	313	325	78	19	38	103	7	3	68	24

Crash History

From 2007 to 2011, there were 49 crashes on the Ironwood Segment between MP 429.7 and MP 430.3, excluding the Northwest Boulevard interchange and the Ironwood intersection. None of the crashes on the segment were fatal, but 20 resulted in injury. At an AADT of approximately 12,000 during those 5 years, this translates to an average of 150 injury crashes per 100 million AVMT. Even though the Northwest Boulevard interchange and the Ironwood intersection are excluded from this number, this injury crash density is still nearly double the statewide average of 79 injury crashes per 100 million AVMT in urban areas during this same time period, as reported in ITD's *Idaho Traffic Crashes 2011*.

Of the 49 crashes that occurred on the Ironwood Segment, 36 were intersection related and an additional 7 were driveway related. There were 15 injury crashes that were either intersection or driveway related. Crashes with pedestrians or bicyclists occurred exclusively at intersections and driveways, and accounted for 3 of these crashes.

In addition to these crashes, there were 14 crashes (5 injury crashes) at the Northwest Boulevard interchange and 23 crashes (11 injury crashes) at the Ironwood intersection. This brings the total number of crashes on the Ironwood Segment to 86, of which 31 were injury crashes. When the Northwest Boulevard interchange and the Ironwood intersection are included in the segment analysis, the injury crash density increases to 200 injury crashes per 100 million AVMT.

Bridge Rating

There are no bridges on the Ironwood Segment.

Performance Measures

US-95 operates well under capacity along the Ironwood Segment. The HCM 2010 specifies LOS A for an urban street that has a speed limit of 35 mph and operates above 30 mph. According to the travel times reported in the KMPO 2010-2035 model, the Ironwood Segment meets this criterion; the reported travel times suggest a peak-hour average speed of approximately 32 mph.

For the intersection at US-95 / Lincoln Way / Walnut Avenue, HCM 2010 methodology was applied manually due to the irregular configuration of the intersection. The results in Table 5 show that the intersection operates acceptably, but it should be noted that the delay in the PM peak is only 2 seconds shy of LOS E.

Table 5. Walnut Avenue Existing Intersection Performance

Intersection	Minor Street			Major Street Left Turn		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
AM Volumes						
Walnut Avenue	0.48	22	C	*(N/A - Free left)*		
PM Volumes						
Walnut Avenue	0.59	33	D	*(N/A - Free left)*		

Future Conditions

SPOKANE RIVER CROSSING SEGMENT

KMPO 2035 projections were used to analyze the projected intersection operations on the Spokane River Crossing Segment. HCS 2010 analysis was used to assess intersection performance. No segment analysis was performed because the existing performance is already deficient.

Since the 2010 base model is considerably different from existing counts, KMPO volume projections were adjusted by the percentage difference between the base model and existing counts. As discussed in the Future Conditions Report, volumes were balanced from Cougar Gulch Road to Fairmont Loop by adjusting the movements turning on or off the highway at each intersection. Where possible, the proportion of turning volume was kept the same as existing as long as the network could remain balanced. The adjusted projections are shown by intersection movement in Table 6.

Table 6. Spokane River Crossing Segment Adjusted 2035 Peak Hour Volumes

Intersection	US 95						Minor Street	
	NBL	NBT	NBR	SBL	SBT	SBR	Left	Right
AM Volumes								
Upriver Drive	90	506	-	-	26	343	97	91
Blackwell Mill Road	*(No AM traffic counts)*							
Fairmont Loop	10	593	-	-	19	369	138	0
PM Volumes								
Upriver Drive	73	557	-	-	597	92	92	108
Blackwell Mill Road	-	605	44	12	627	-	62	8
Fairmont Loop	85	528	-	-	624	294	61	15

Using these numbers, HCS analysis was conducted on the Spokane River Crossing Segment intersections. As Table 7 shows, all three intersections operate at LOS E or F in the PM peak hour. Since this LOS is undesired, analysis of the 2020 projections was conducted to reveal how soon the intersections would operate unacceptably.

Table 7. Spokane River Crossing Segment 2035 Intersection Performance

Intersection	Minor Street			Major Street Left Turn		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
AM Volumes						
Upriver Drive	0.56	27	D	0.08	8	A
Blackwell Mill Road	*(No AM traffic counts)*					
Fairmont Loop	0.60	40	E	0.01	8	A
PM Volumes						
Upriver Drive	0.77	52	F	0.09	9	A
Blackwell Mill Road	0.44	41	E	0.01	9	A
Fairmont Loop	0.49	47	E	0.13	11	B

Table 8 shows the adjusted 2020 projections, and Table 9 indicates that these intersections will operate acceptably with the adjusted 2020 volumes.

Table 8. Spokane River Crossing Segment Adjusted 2020 Peak Hour Volume Projections

Intersection	US 95						Minor Street	
	NBL	NBT	NBR	SBL	SBT	SBR	Left	Right
AM Volumes								
Upriver Drive	8	468	-	-	335	35	146	2
Blackwell Mill Road	*(No AM traffic counts)*							
Fairmont Loop	0	614	-	-	358	25	36	12
PM Volumes								
Upriver Drive	30	484	-	-	523	136	80	7
Blackwell Mill Road	-	554	10	11	648	-	11	10
Fairmont Loop	22	542	-	-	652	48	39	7

Table 9. Spokane River Crossing Segment 2020 Intersection Performance

Intersection	Minor Street			Major Street Left Turn		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
AM Volumes						
Fairmont Loop	0.15	19	C	*(No left turn volume)*		
PM Volumes						
Upriver Drive	0.38	29	D	0.03	9	A
Blackwell Mill Road	0.06	20	C	0.01	9	A
Fairmont Loop	0.24	30	D	0.03	9	A

IRONWOOD SEGMENT

KMPO 2035 projections were used to conduct operational analysis on the Ironwood Segment. Intersection analysis was performed at the US-95 / Lincoln Way / Walnut Avenue intersection using HCM 2010 methodology. HCM segment analysis could not be performed because HCM methodology for urban segments deals mainly with signal progression and assumes an urban segment lies between two signalized intersections.

Intersection operations were analyzed using both unadjusted and adjusted KMPO projections. The volume adjustment used the same procedure as above for the purpose of aligning the base model with existing counts. The unadjusted projections were used for purposes of comparing the existing configuration with the scenarios in the next section, because adjustments could not be applied to other configurations besides existing. Both the unadjusted and adjusted volume projections are shown in Table 10.

Table 10. US-95 / Lincoln Way / Walnut Ave Peak Hour Volume Projections

Model	US 95						Lincoln Way			Walnut Avenue		
	SBL	SBT	SBR	EBL	EBT	EBR	NBL	NBT	NBR	WBL	WBT	WBR
PM Volumes												
Unadjusted												
2020	81	379	941	386	93	22	188	508	36	5	96	34
2035	97	454	1127	460	110	26	236	638	45	6	130	46
Adjusted												
2020	48	227	564	441	106	25	57	154	11	5	96	34
2035	58	272	676	526	126	30	72	194	14	6	130	46

Since the adjusted volumes are, for the most part, lower than the unadjusted volumes, results can be expected to be more favorable when using the adjusted volumes. Still, the results in Table 11 show that both versions operate at LOS F in 2020.

Table 11. Walnut Avenue Projected Intersection Performance

Model	Lincoln Way SB			Lincoln Way NB			Walnut Ave		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
PM Volumes									
Unadjusted									
2020	1.97	477	F	1.67	343	F	0.73	62	F
2035	2.63	781	F	2.59	753	F	1.33	250	F
Adjusted									
2020	1.23	169	F	0.59	33	D	0.58	39	E
2035	1.64	347	F	0.93	87	F	1.01	121	F

The other cross streets on the Ironwood Segment do not have turning movement counts available; however, a threshold analysis is still possible. Using the existing configuration and assuming a peak hour factor (PHF) of 0.92 to adjust volumes to the peak 15 minutes, a single through vehicle on a cross street (i.e., 1 veh/hr) will experience LOS E when US-95 has 700 veh/hr in each direction. This is expected to occur by 2020.

Analysis of Scenarios

SPOKANE RIVER CROSSING SEGMENT

Several scenarios for the Spokane River Crossing Segment were analyzed using KMPO projections. Scenario 1, the preferred alternative from the 2003 US-95 Coeur d'Alene Corridor Study, widens US-95 to four lanes and provides access to Upriver Drive, Blackwell Mill Road, Fairmont Loop, and Marina Drive from a single diamond interchange. Scenario 2 also widens US-95 to four lanes, but it controls the cross streets with a signal instead of an interchange.

The adjusted 2035 volume projections were used to analyze the scenarios. Only the PM peak hour projections were used, since every link except one was projected to carry higher volumes in the PM peak than in the AM peak. Because the observed PHF was different at each intersection where counts were taken, the future PHF was assumed to be 0.92. Hourly volume projections were divided by this number to adjust volumes to the peak 15 minutes. The assumed distribution of turning movement volumes can be seen in Appendix B with detailed reports of all Spokane River Crossing Segment Analysis.

Since all scenarios widen US-95 to four lanes, reconstruction of the Blackwell Slough Bridge and Spokane River Bridge would be necessary to accommodate the additional lanes.

Scenario 1: Access at Blackwell Island

The objective of Scenario 1 is to serve all roads in the vicinity from a single access point on Blackwell Island. This could be achieved with a diamond interchange (Figure 5) or with an at-grade signalized intersection (Figure 6). Fairmont Loop would cross the Blackwell Slough to connect with Marina Drive. Lakeview Drive and Upriver Drive would access the highway by being extended to Fairmont Loop, and Blackwell Mill Road would pass under the highway to connect to Lakeview Drive.

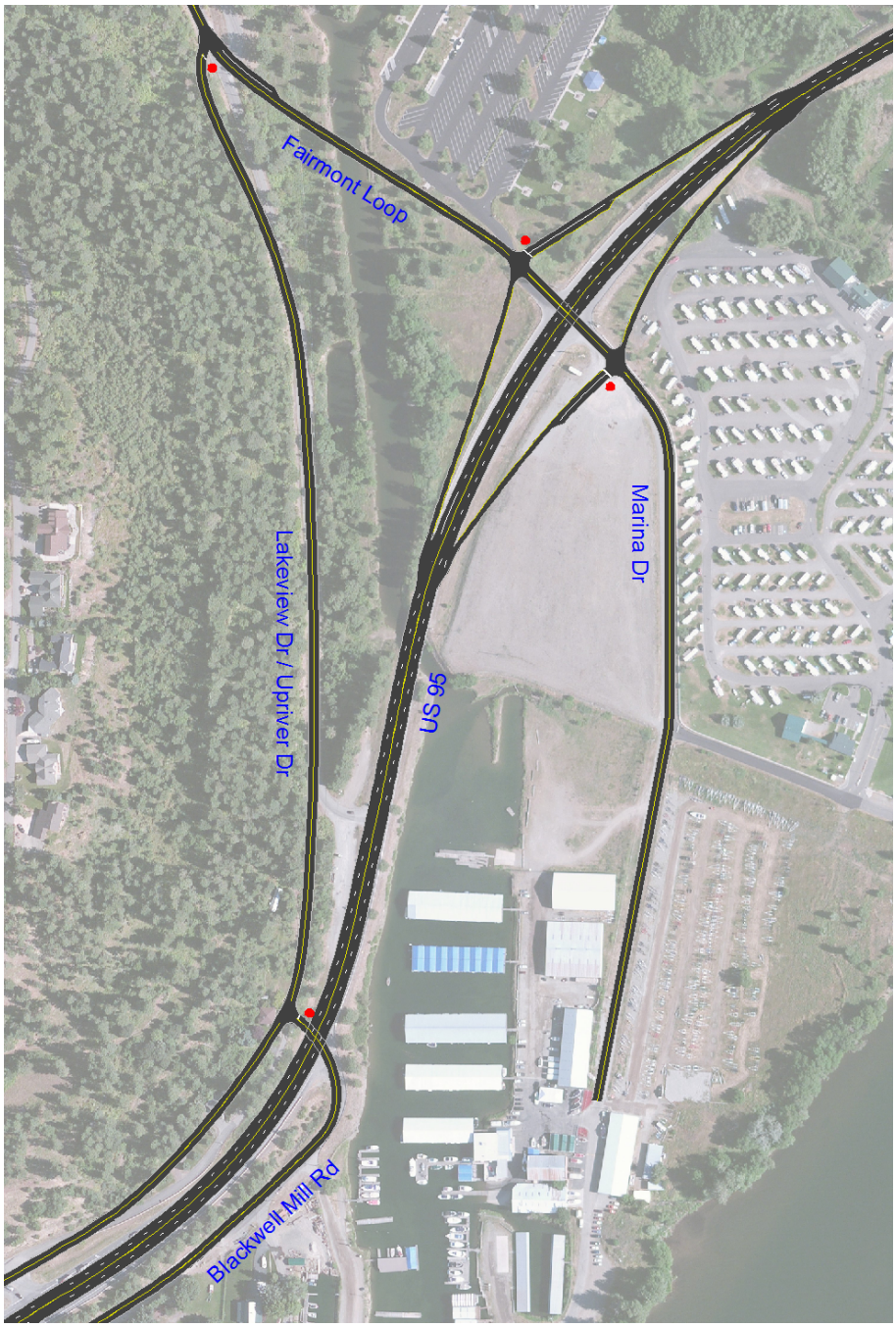


Figure 5. Diamond Interchange Configuration on Blackwell Island

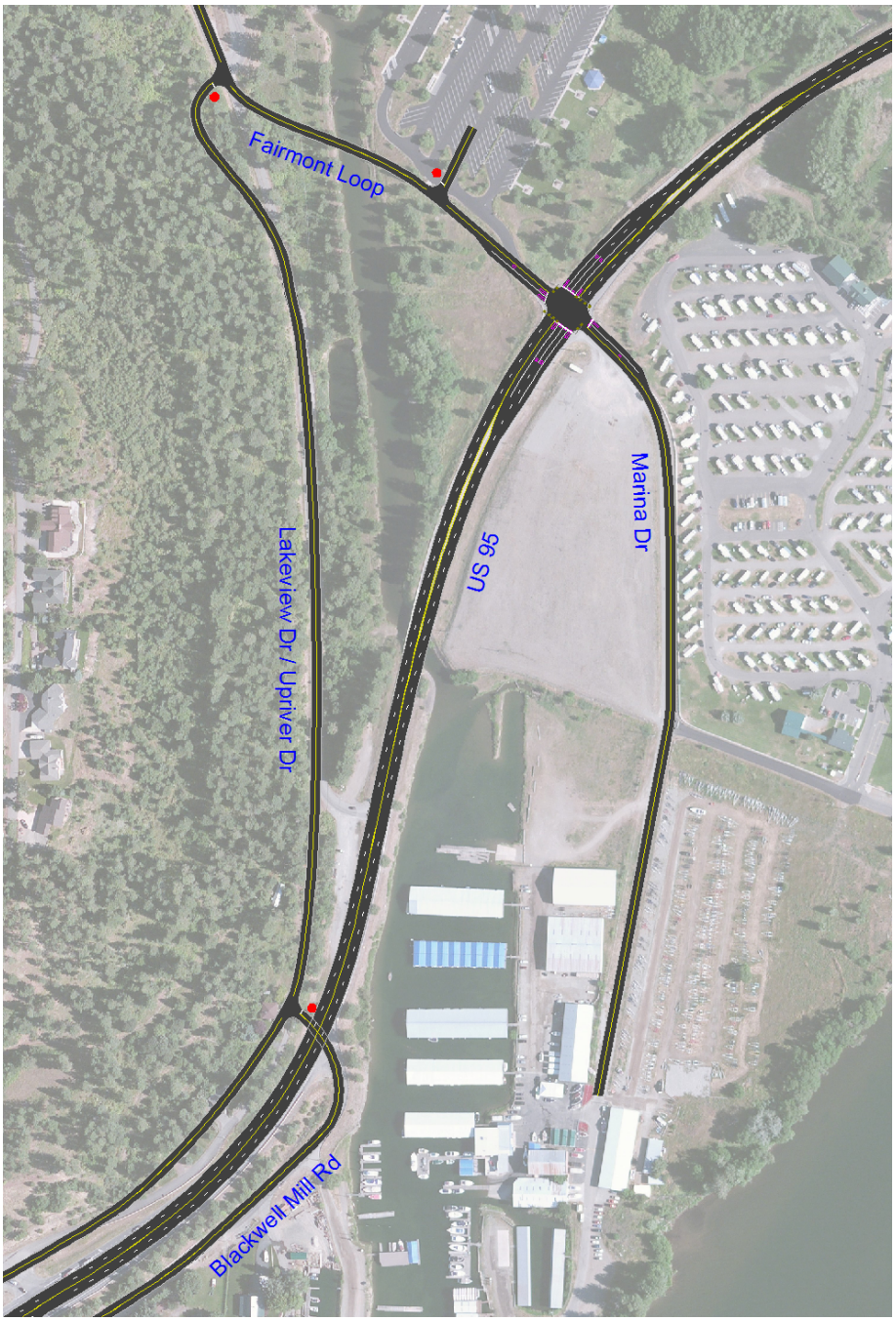


Figure 6. At-grade Signalized Intersection Configuration on Blackwell Island

For both the diamond interchange and the at-grade signalized intersection, Scenario 1 performance is acceptable under the adjusted 2035 PM peak hour volumes (Table 12). For the diamond interchange, the worst approach is LOS C at the US-95 northbound ramps; all other intersection approaches operate at A or B. The signalized intersection performs somewhat worse, though still acceptable. Left turns from US 95 experience LOS D, and the Fairmont Loop approach experiences LOS C.

Table 12. Diamond Interchange Results

Scenario and Intersection	Minor Street			US-95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
PM Volumes						
Scenario 1: Access at Blackwell Island						
a) Diamond Interchange						
NB Ramps / Marina Drive	0.13	8	A	0.51	22	C
SB Ramps / Fairmont Loop	0.01	8	A	0.40	14	B
Fairmont Loop / Lakeview Drive	0.30	10	B	0.16	8	A
Lakeview Drive / Blackwell Mill Road	0.09	10	A	0.05	8	A
b) At-grade Signalized Intersection						
US-95 / Fairmont Loop / Marine Drive	0.60	21	C	0.90	36	D

Scenario 2: Signal

Scenario 2 seeks to reduce construction costs by minimizing the amount of new road construction required. This scenario is similar to Scenario 1 in its use of a four-lane US-95 and the extension of Lakeview Drive to meet Fairmont Loop. The extension of Lakeview Drive provides access to both Fairmont Loop and Upriver Drive with only one signal, which could be placed either at Blackwell Mill Road or Fairmont Loop. Upriver Drive was not considered as a feasible signal location due to the 60 mph speed limit on the southwest side of the intersection.

With two-way stop control (TWSC) at the entrance to the Blackwell Island Recreation Site (directly across the highway from Marina Drive), volumes on US-95 are heavy enough to cause left turns exiting the site to operate at LOS F. To address this issue, an exit-only was modeled north of the existing entrance/exit and was provided a two-way left turn lane on US-95 before the bridge. This improves LOS by allowing two-stage gap acceptance for vehicles to turn across southbound traffic and then wait for a gap in northbound traffic.

Figure 7 shows the configuration with a signal at Blackwell Mill Road, where highway access to Lakeview Drive would create a four-leg intersection on US-95. A signal would also be necessary at the proposed Lakeview Drive / Blackwell Mill Road intersection to provide for adequate vehicle storage. This signal would likely operate on the same controller. With the provision of right-turn access at the existing Fairmont Loop and Upriver Drive intersections, right turns from southbound US-95 would be virtually unnecessary. This allows for US-95 to be 5 lanes wide at the signal instead of 6 lanes. Northbound left-turn access would also be provided at Upriver Drive, reducing the amount of demand conflicting with southbound US-95 at the signal. Results of this option (Table 13) indicate that all intersections would operate at LOS C or better under the adjusted 2035 volumes.

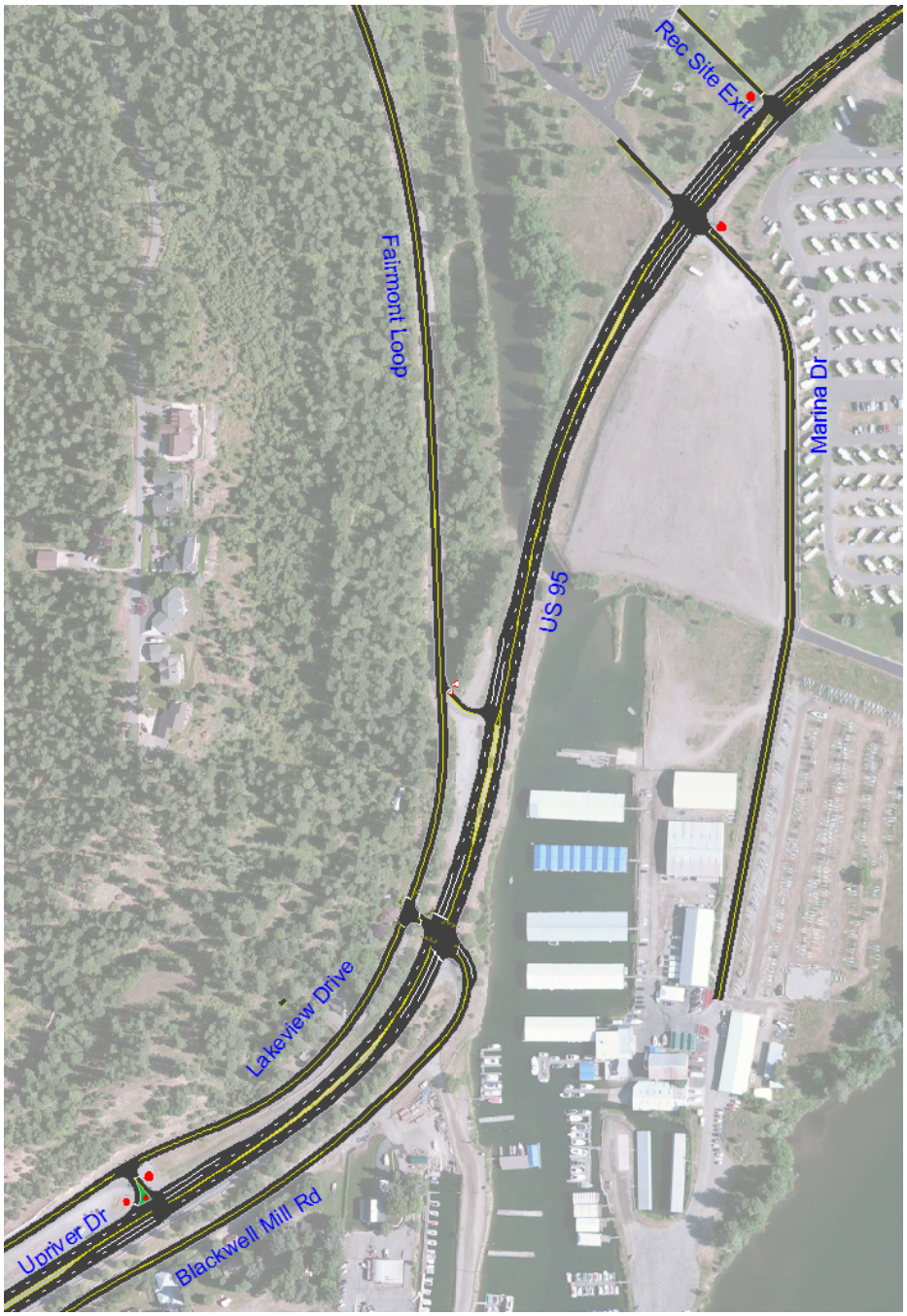


Figure 7. Signal Configuration at Blackwell Mill Road

Table 13. Signal Results at Blackwell Mill Road

Scenario and Intersection	Minor Street			US-95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
PM Volumes						
Scenario 2: Signal						
a) Signal at Blackwell Mill Road						
Upriver Drive / Lakeview Drive	0.22	11	B	*(N/A - No Left Turn Volume)*		
US-95 / Blackwell Mill Road	0.34	16	B	0.50	16	B
Lakeview Drive / Blackwell Mill Road*	-	11	B	-	28	C
US-95 / Marina Drive	0.16	15	C	0.09	9	A
US-95 / Recreation Site Exit	0.16	23	C	*(N/A - No Left Turn)*		

**Based on the average of 10 simulation runs in SimTraffic*

Figure 8 shows the option of placing the signal at the existing Fairmont Loop intersection. Again, a second signal operating on the same controller would likely be necessary to allow for adequate storage on the minor street. Blackwell Mill Road would remain as a TWSC intersection, and Upriver Drive would be configured the same as in the previous option. Table 14 indicates that results are similar to the previous option, with all intersections operating at LOS C or better under the adjusted 2035 volumes.

Table 14. Signal Results at Fairmont Loop

Scenario and Intersection	Minor Street			US-95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
PM Volumes						
Scenario 2: Signal						
b) Signal at Fairmont Loop						
Upriver Drive / Lakeview Drive	0.22	11	B	*(N/A - No Left Turn Volume)*		
US-95 / Blackwell Mill Road	0.26	24	C	0.01	9	A
US-95 / Fairmont Loop*	-	8	A	-	17	A
Fairmont Loop / Lakeview Drive*	-	19	B	-	4	A
US-95 / Marina Drive	0.16	15	C	0.09	9	A
US-95 / Recreation Site Exit	0.16	23	C	*(N/A - No Left Turn)*		

**Based on the average of 10 simulation runs in SimTraffic*

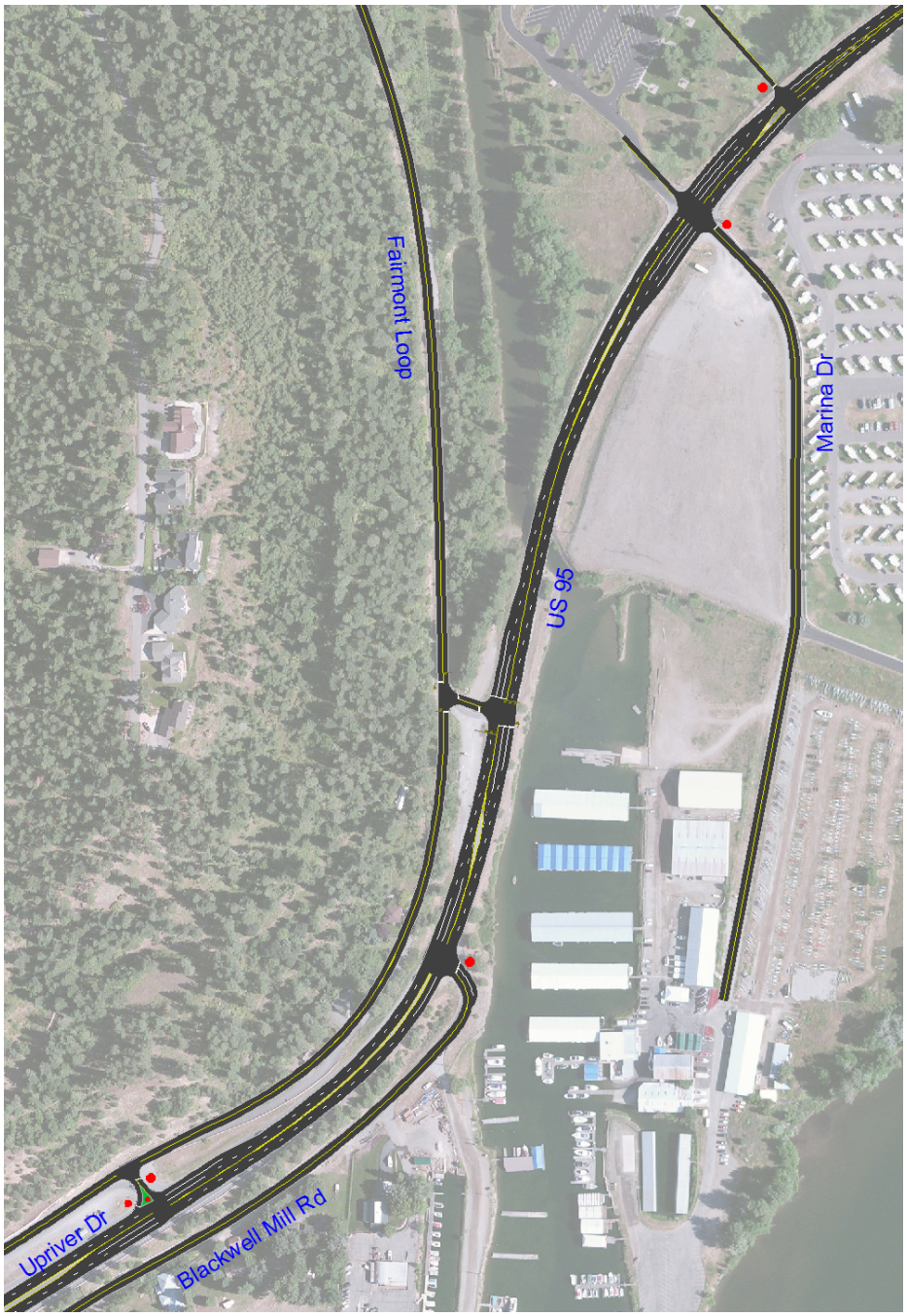


Figure 8. Signal Configuration at Fairmont Loop

Summary of Spokane River Crossing Segment Scenarios

Table 15 compares the performance of the two scenarios for the Spokane River Crossing Segment and shows that both scenarios produce an acceptable LOS. LOS is only one consideration, however, especially in the case of the Spokane River Crossing Segment. Safety and cost effectiveness are two primary criteria of any road improvement project. Due to the safety and performance benefits associated with reducing access to a single point, Scenario 1 is recommended. The diamond interchange option would be safer than the at-grade signalized intersection and is preferred if funding allows.

If one of the Scenario 2 options were to be used, the signal at Blackwell Mill Road poses a higher safety concern. It is located at the bottom of a grade that would increase stopping sight distance, especially for heavy vehicles, and would be especially hazardous in winter conditions. Furthermore, there may be sight distance constraints due to the intersection being on a horizontal and vertical curve. In contrast, the existing Fairmont Loop intersection is on a section of highway that is relatively flat and straight. Since its performance was similar to the Blackwell Mill Road option, Fairmont Loop would be a more desirable signal location if Scenario 2 is ultimately chosen.

Table 15. Results of All Scenarios for the Spokane River Crossing Segment

Scenario and Intersection	Minor Street			US-95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
PM Volumes						
Scenario 1: Access at Blackwell Island						
a) Diamond Interchange						
NB Ramps / Marina Drive	0.13	8	A	0.51	22	C
SB Ramps / Fairmont Loop	0.01	8	A	0.40	14	B
Fairmont Loop / Lakeview Drive	0.30	10	B	0.16	8	A
Lakeview Drive / Blackwell Mill Road	0.09	10	A	0.05	8	A
b) At-grade Signalized Intersection						
US-95 / Fairmont Loop / Marine Drive	0.60	21	C	0.90	36	D
Scenario 2: Signal						
a) Signal at Blackwell Mill Road						
Upriver Drive / Lakeview Drive	0.22	11	B	*(N/A - No Left Turn Volume)*		
US-95 / Blackwell Mill Road	0.34	16	B	0.50	16	B
Lakeview Drive / Blackwell Mill Road*	-	11	B	-	28	C
US-95 / Marina Drive	0.16	15	C	0.09	9	A
US-95 / Recreation Site Exit	0.16	23	C	*(N/A - No Left Turn)*		
b) Signal at Fairmont Loop						
Upriver Drive / Lakeview Drive	0.22	11	B	*(N/A - No Left Turn Volume)*		
US-95 / Blackwell Mill Road	0.26	24	C	0.01	9	A
US-95 / Fairmont Loop*	-	8	A	-	17	A
Fairmont Loop / Lakeview Drive*	-	19	B	-	4	A
US-95 / Marina Drive	0.16	15	C	0.09	9	A
US-95 / Recreation Site Exit	0.16	23	C	*(N/A - No Left Turn)*		

**Based on the average of 10 simulation runs in SimTraffic*

IRONWOOD SEGMENT: WALNUT AVENUE INTERSECTION

Using 2035 KMPO projections, operational performance was analyzed for several scenarios from the 2003 US-95 Coeur d'Alene Corridor Study. KMPO modified their build model to match the configuration of each scenario. Scenarios included an at-grade intersection, partial interchange, diamond interchange, and the 2003 study's preferred alternative of a signal and Harrison Avenue realignment. The last scenario includes slightly modifying the US-95 alignment within existing right-of-way and restricting various movements. Only the PM peak hour was used in the analysis for all scenarios, as the AM peak hour produced lower volumes for almost every movement. The assumed distribution of turning movement volumes can be seen in Appendix C with the detailed reports of all Ironwood Segment analysis.

Scenario 1: At Grade Intersection

The original at-grade intersection proposed in the 2003 study included a T-intersection at US-95 / Walnut Avenue and a second T-intersection at Lincoln Way / Walnut Avenue. As shown in Figure 9, this configuration was modified to provide free access to the right lane of northbound US-95.

Operational performance was analyzed in Synchro using HCM 2010 methodology, and the results are shown in Table 16. The Lincoln Way / Walnut Avenue intersection operated at LOS C, but the US-95 / Lincoln Way intersection was over capacity both on the Lincoln Way approach and on the US-95 southbound left turn.

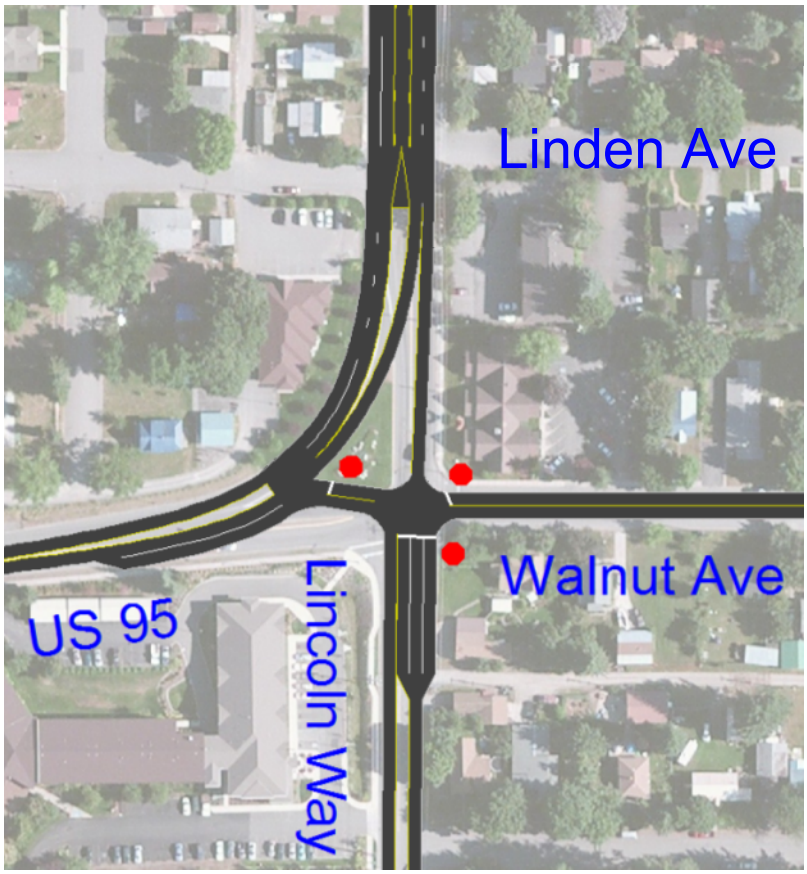


Figure 9. At Grade Intersection Configuration (Red Dots Indicate Stop Signs)

Table 16: At Grade Intersection Results

Scenario and Intersection	Minor Street			US-95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
PM Volumes						
Scenario 1: At Grade Intersection						
US-95 / Walnut Avenue	49.9	23440	F	1.15	114	F
Lincoln Way / Walnut Avenue	0.40	21	C	*(N/A - Free Approach)*		

Scenario 2: Partial Interchange

The partial interchange scenario from the 2003 study includes off ramps in both directions and an on ramp for northbound US-95 only. Mainline US-95 would have four lanes throughout the interchange. Figure 10 shows the interchange configuration, which includes an optional roundabout where the US-95 ramps intersect with Lincoln Way and Walnut Avenue. Figure 11 shows the modeled roundabout configuration.

The merge and diverge areas cannot be analyzed using HCM methodology, which requires a minimum free-flow speed of 55 mph—well above the 35 mph speed limit. These areas were nonetheless checked using a 55 mph free-flow speed and the projected volumes, and performance was acceptable. The roundabout was analyzed in Sidra 5.1 using Sidra default methodology with no entry/circulating flow adjustment. The results in Table 17 show that the roundabout performs at LOS C. Two-way stop control and all-way stop control were analyzed in Synchro and performed at LOS F.

Figure 10. Partial Interchange Configuration

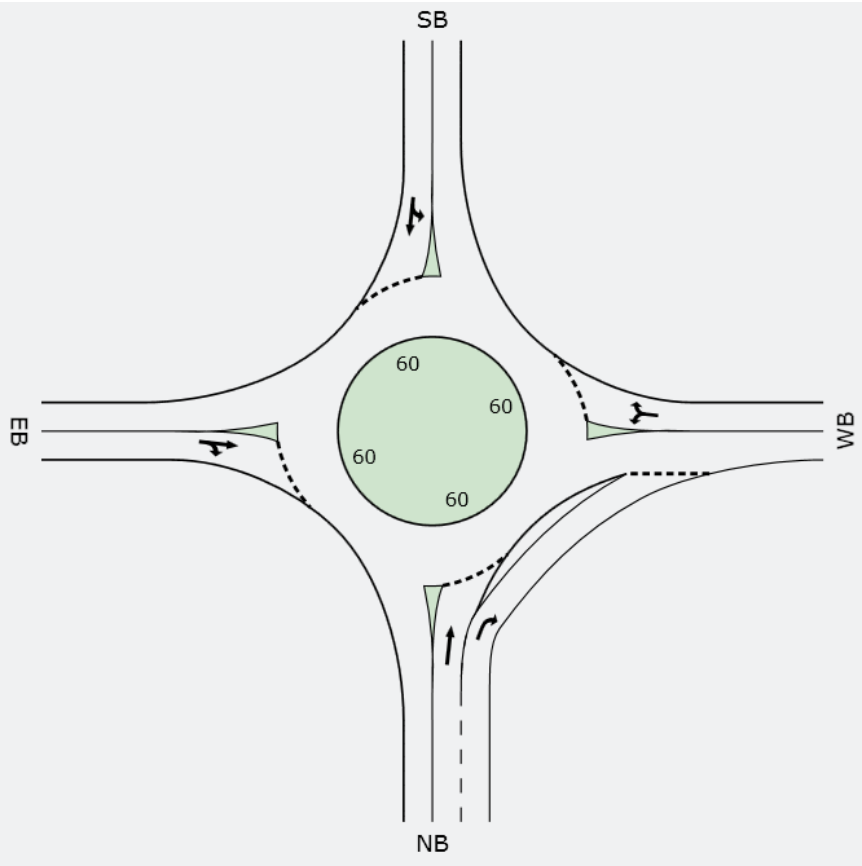


Figure 11. Roundabout Configuration

Table 17. Partial Interchange Results

Scenario and Intersection	Minor Street			US-95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
PM Volumes						
Scenario 2: Partial Interchange						
US-95 Ramps / Lincoln Way / Walnut Ave	0.84	21	C	0.78	26	C

Scenario 3: Diamond Interchange

The diamond interchange scenario in Figure 12 includes a four-lane US-95 with a realignment of Harrison Avenue crossing over (or under) US-95 and connecting with Northwest Boulevard. Projected 2035 volumes are low enough to allow for TWSC at the ramp intersections on Harrison Avenue. The analysis in Synchro followed the HCM 2010 methodology, and the results in Table 18 indicate an LOS D at both off ramps. The US-95 ramps are considered the minor street in the table.

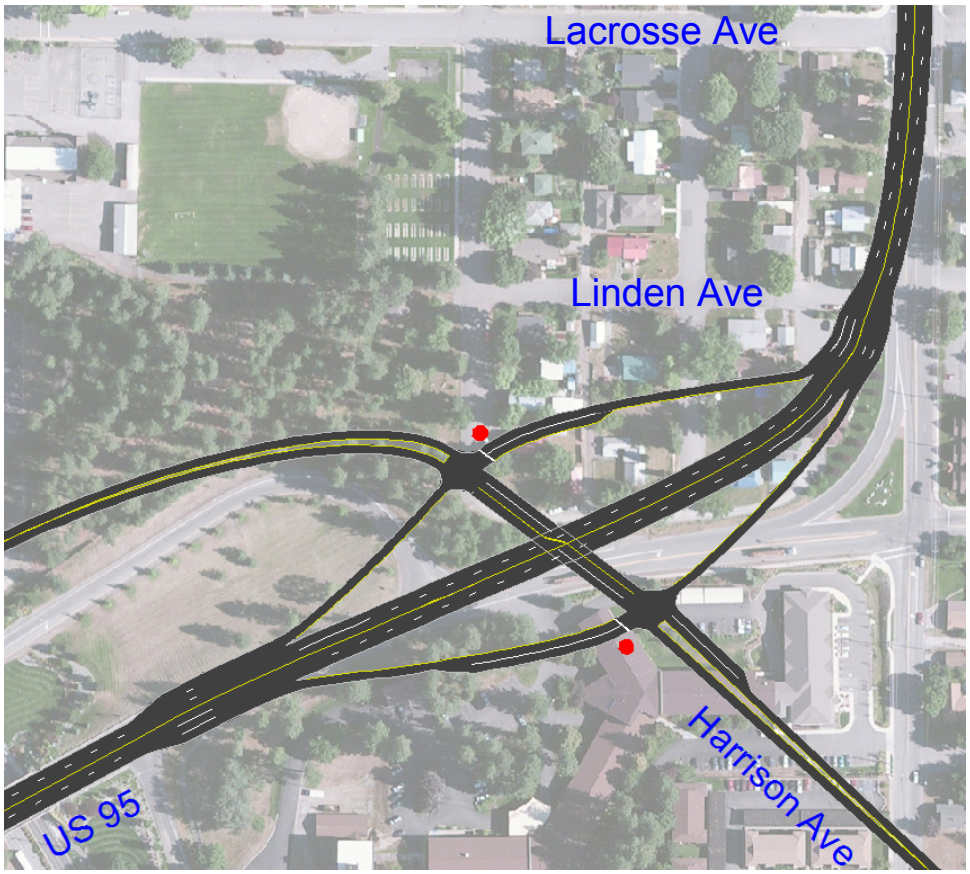


Figure 12. Diamond Interchange Configuration

Table 18. Diamond Interchange Results

Scenario and Intersection	Minor Street			US-95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
PM Volumes						
Scenario 3: Diamond Interchange						
US-95 NB Ramps / Harrison Avenue	0.37	28	D	0.15	11	B
US-95 SB Ramps / Harrison Avenue	0.65	31	D	0.03	8	A

Scenario 4: Signal

The preferred scenario in the 2003 study was a four-lane US-95 with signal control at a realigned Harrison Avenue. Figure 13 shows the modeled configuration. The Synchro results

in Table 19 show an LOS B for the US-95 through movements, LOS D for US-95 left turns, and LOS D for Harrison Avenue.

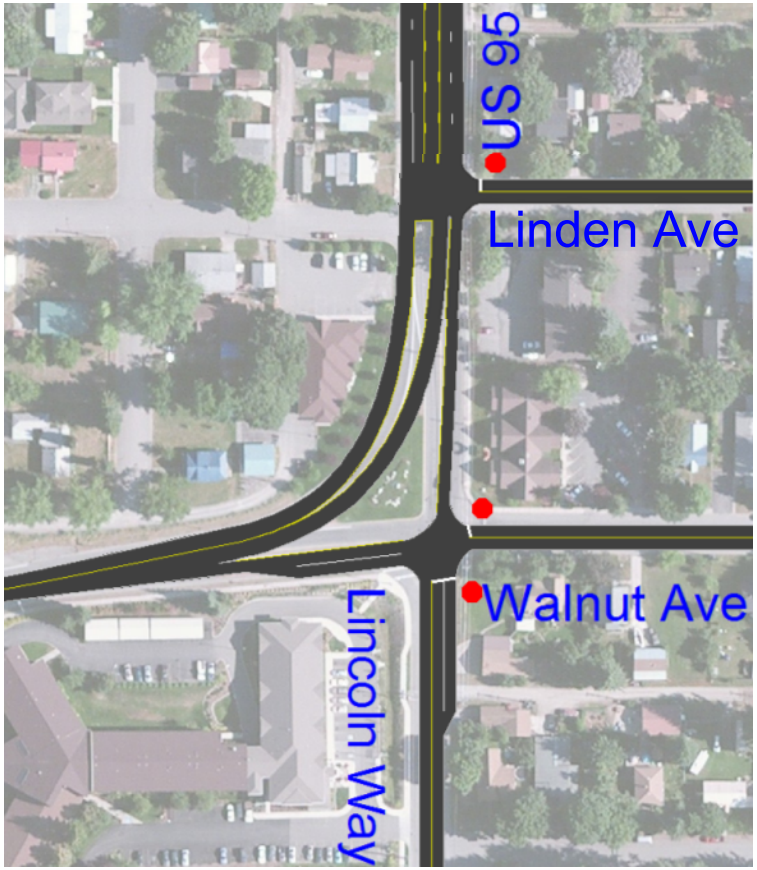
Figure 13. Signal Configuration

Table 19. Signal Results

Scenario and Intersection	Minor Street			US-95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
PM Volumes						
Scenario 4: Signal						
US-95 / Harrison Avenue	0.61	26	C	0.81	34	C

Scenario 5: Movement Restrictions

Unlike the previous scenarios, Scenario 5 does not increase the number of lanes on US-95. This allows northbound US-95 to be placed next to the southbound lane along the existing curve, which enables traffic to maintain speeds close to the 35-mph speed limit. The scenario is divided into four different options for restricting certain movements. The first option (Figure 14 left) includes the minimum number of movement restrictions needed to accommodate the realignment of northbound US-95. The restricted movements are the southbound through and left, westbound through, and northbound left. Option B (Figure 14 right) also restricts the eastbound through movement in order to remove the stop sign on northbound Lincoln Way. Option C (Figure 15 left) completely removes access to Lincoln Way by adding a restriction to the eastbound right turn movement. Finally, Option D (Figure 15 right) removes access to northbound US-95 but maintains access to Lincoln Way.



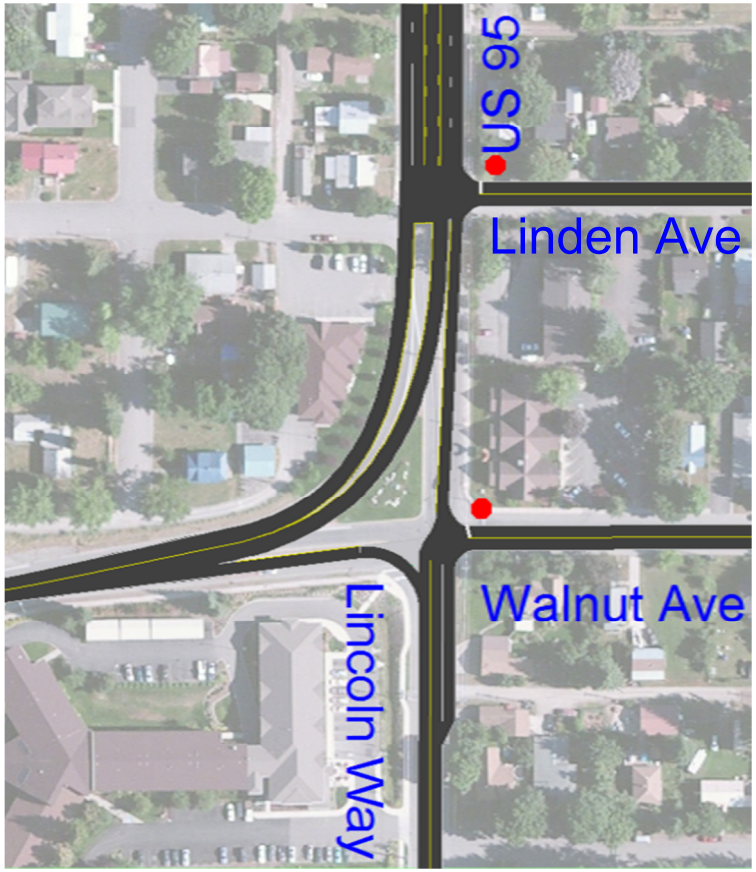


Figure 14. Movement Restriction A (left) and Movement Restriction B (right)

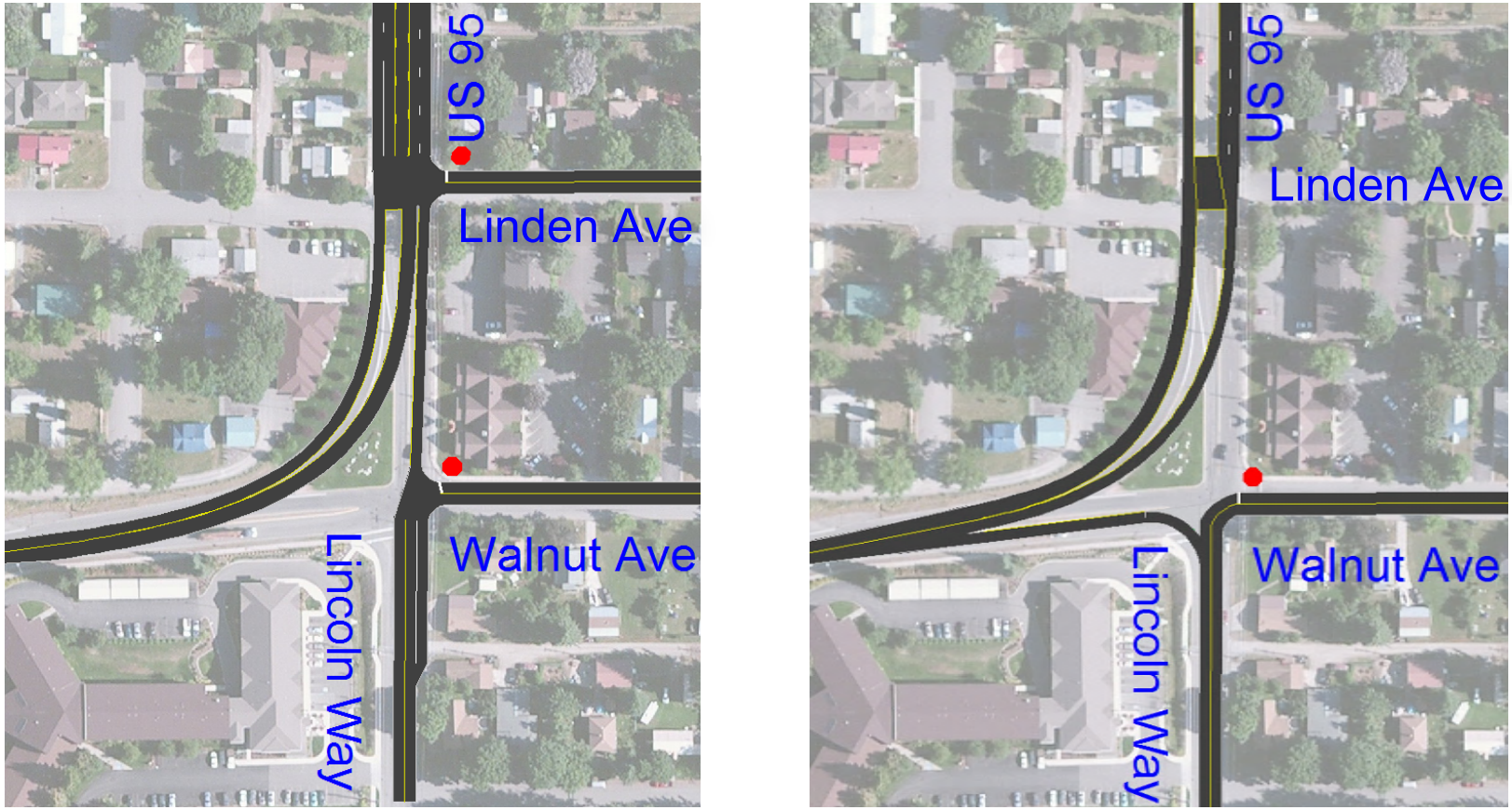


Figure 15. Movement Restriction C (left) and Movement Restriction D (right)

Table 20 compares the results of the four movement restriction options, where Lincoln Way is considered to be the major street. Option A performed poorly for Lincoln Way, since a large volume of traffic was required to stop. Option B performed much better with Lincoln Way being uncontrolled. In the KMPO model for Option C, there was a higher volume on Walnut Avenue, which led to more delay than Option B. Since there was no northbound through volume on Option D, the only conflict with Walnut Avenue was the volume coming off US-95. Because of this, the intersection LOS improved dramatically above the other options.

Table 20. Movement Restriction Results

Scenario and Intersection	Minor Street			US-95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
PM Volumes						
Scenario 5: Movement Restrictions						
a) No SB, WBT, NBL						
Lincoln Way / Walnut Avenue	0.32	15	B	0.99	56	F
b) No SB, WBT, NBL, EBT						
Lincoln Way / Walnut Avenue	0.34	23	C	*(N/A - Free Approach)*		
c) No SB, WBT, NBL, EBT/R						
Lincoln Way / Walnut Avenue	0.71	33	D	*(N/A - Free Approach)*		
d) No SB, WBT/R, NBT/L, EBT						
Lincoln Way / Walnut Ave	0.07	9	A	*(N/A - Free Approach)*		

Summary of Walnut Avenue Scenarios

Table 21 repeats the information from the previous tables for the purpose of comparing results among scenarios. Scenario 1 and Scenario 5a did not produce an acceptable LOS. Among the remaining options, Scenarios 2, 4, 5b, and 5d produced the most favorable LOS. Scenarios 5b and 5d would be the least expensive option to implement, since they use existing right-of-way. Their disadvantage, however, is the restriction of movements that could negatively impact the larger network. An analysis of the surrounding network is needed to more fully understand the impacts of this alternative.

Table 21. Results of All Scenarios at US-95 / Lincoln Way / Walnut Ave

Scenario and Intersection	Minor Street			US 95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
PM Volumes						
Scenario 1: At Grade Intersection						
US 95 / Walnut Ave	49.9	23440	F	1.15	114	F
Lincoln Way / Walnut Ave	0.40	21	C	*(N/A - Free Approach)*		
Scenario 2: Partial Interchange						
US 95 Ramps / Lincoln Way / Walnut Ave	0.84	21	C	0.78	26	C
Scenario 3: Diamond Interchange						
US-95 NB Ramps / Harrison Ave	0.37	28	D	0.15	11	B
US-95 SB Ramps / Harrison Ave	0.65	31	D	0.03	8	A
Scenario 4: Signal						
US-95 / Harrison St	0.61	26	C	0.81	34	C
Scenario 5: Movement Restrictions						
a) No SB, WBT, NBL						
Lincoln Way / Walnut Ave	0.32	15	B	0.99	56	F
b) No SB, WBT, NBL, EBT						
Lincoln Way / Walnut Ave	0.34	23	C	*(N/A - Free Approach)*		
c) No SB, WBT, NBL, EBT/R						
Lincoln Way / Walnut Ave	0.71	33	D	*(N/A - Free Approach)*		
d) No SB, WBT/R, NBT/L, EBT						
Lincoln Way / Walnut Ave	0.07	9	A	*(N/A - Free Approach)*		

Network Analysis

Since the movement restrictions scenario is expected to be effective at a relatively low cost, the impact of the scenario on the surrounding network was analyzed using traffic projections and additional traffic counts on side streets. Northwest Boulevard and Government Way were the east-west boundaries, while the north-south boundaries were Hubbard Avenue and Ironwood Drive.

Before running the analysis, several goals for the network were considered. First, the City of Coeur d'Alene is seeking to reduce through traffic on Walnut Avenue in response to resident complaints. The goal is to shift traffic onto Harrison Avenue, which is already established as a minor arterial. This is another reason to use Scenario 5b or 5d, which allows northbound US-95 to access Harrison Avenue via Lincoln Way.

Another objective is to reduce the number of access points and conflict areas on US-95. This would suggest the use of Scenario 5d. Access management on the side streets will also need to be considered between Walnut Avenue and Ironwood Drive. The 2003 US-95 Coeur d'Alene Corridor Study contains refined options for access management, which are reproduced from that report in Figure 16. The KMPO model used in this network analysis included Scenario 5d and the access management recommendations from the 2003 study. Appendix D contains detailed reports of this network analysis.

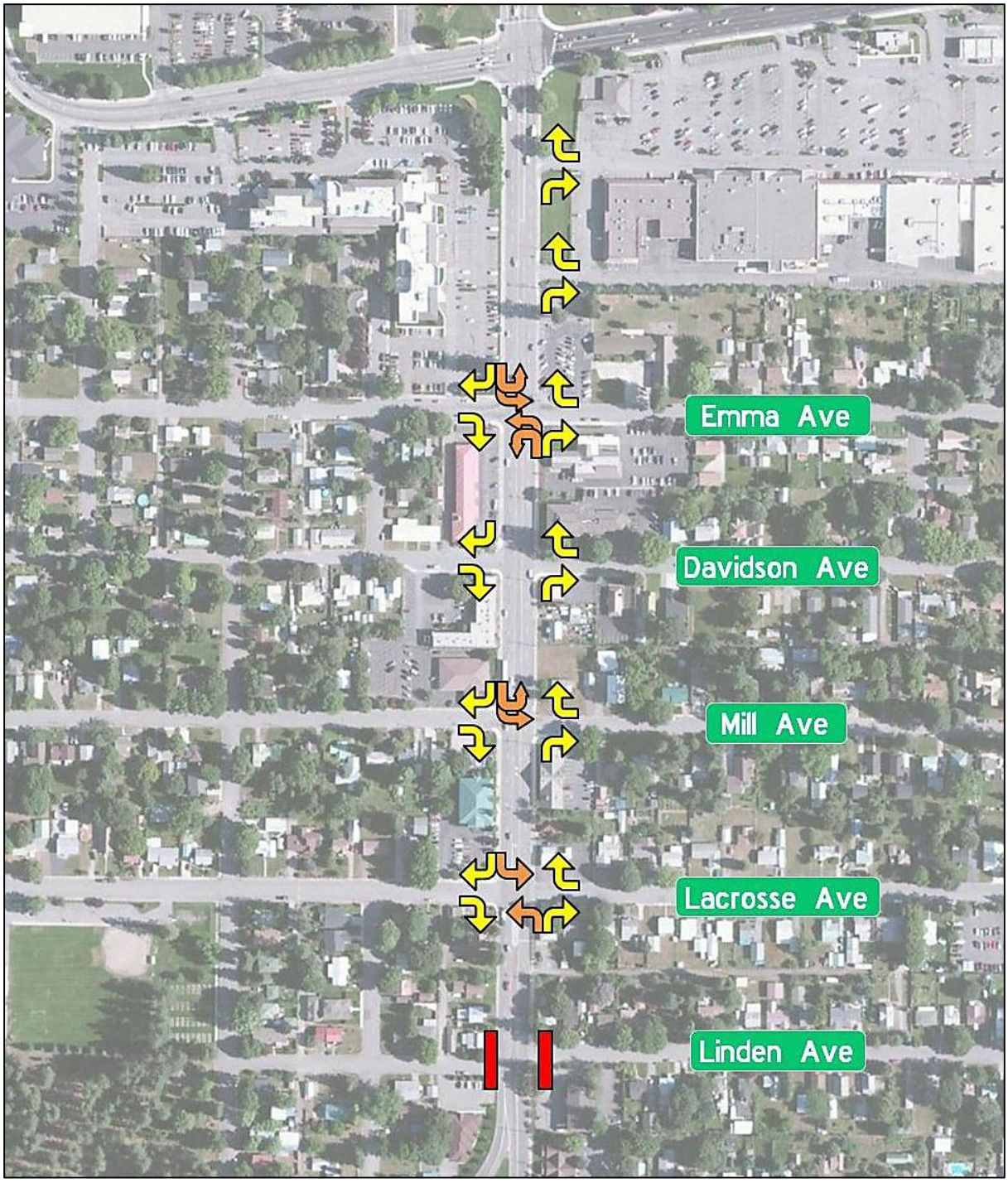


Figure 16. Access Management Recommendations from the 2003 Study

Intersection Operations

The 2035 KMPO model was used to show changes in projected traffic volumes under the proposed modifications. The road segments with more than a 15% increase in AM or PM peak hour traffic included northbound Northwest Boulevard leading to US 95, both directions of Harrison Avenue within the study area, both directions of Government Way, and eastbound Hubbard Avenue. The increase on Hubbard Avenue is not likely to be a concern, as the projected volume only increased to 69 vehicles per hour.

Three major intersections lie on the segments with a projected increase in traffic: US-95 / NB Northwest Boulevard off ramp, Government Way / Harrison Avenue, and Government Way/ Ironwood Drive. Turning movement volumes were estimated at these intersections by balancing the incoming and outgoing traffic in the KMPO model. These volumes were then used to analyze intersection performance. The intersection at US-95 / NB Northwest Boulevard off ramp is controlled by a stop sign on the off ramp and was analyzed in HCS 2010. The other two intersections are signalized and were analyzed in Synchro according to HCM 2010 methodology.

Table 22 shows the intersection performance at the three intersections where the proposed modifications are expected to increase traffic volumes by more than 15%. The table compares performance under existing US-95 configuration to performance under the proposed modifications.

Table 22. Performance of Intersections Affected by Proposed Modifications

Intersection	Minor Street			US 95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
2035 AM Volumes						
US-95 / Northwest Boulevard						
Existing US-95 Configuration	1.52	397	F	*(N/A - Free Approach)*		
Proposed US-95 Configuration	1.89	492	F	*(N/A - Free Approach)*		
Government Way / Harrison Avenue						
Existing US-95 Configuration	0.62	18	B	0.83	21	D
Proposed US-95 Configuration	0.91	54	D	0.95	37	D
Proposed Configuration, 2 EBL lanes	0.85	32	C	0.95	30	C
Government Way / Ironwood Drive						
Existing US-95 Configuration	1.10	96	F	1.20	83	F
Proposed US-95 Configuration	1.08	90	F	1.18	91	F
2035 PM Volumes						
US-95 / Northwest Boulevard						
Existing US-95 Configuration	7.09	2810	F	*(N/A - Free Approach)*		
Proposed US-95 Configuration	5.36	2041	F	*(N/A - Free Approach)*		
Government Way / Harrison Avenue						
Existing US-95 Configuration	0.96	40	D	0.91	30	C
Proposed US-95 Configuration	0.98	71	E	.91	62	E
Proposed Configuration, 2 EBL lanes	0.92	49	D	0.89	50	D
Government Way / Ironwood Drive						
Existing US-95 Configuration	1.13	156	F	1.06	78	F
Proposed US-95 Configuration	1.16	177	F	1.07	76	F

As can be seen, the intersection at US-95 / NB Northwest Boulevard off ramp is expected to operate at LOS F in both existing and proposed cases. The proposed case performs worse than existing in the AM peak but improves performance in the PM peak. The Government Way/ Ironwood Drive intersection is also expected to operate at LOS F. At both of these intersections, the difference between the existing and proposed cases is negligible.

The intersection at Government Way / Harrison Avenue performs significantly worse under the proposed case. While it still operates under capacity, delay results in LOS E. This increase in delay is due to a high eastbound left turn demand, which requires green time that would

otherwise be allocated to Government Way. Since this is the main cause of delay, a second eastbound left turn lane would reduce delay to LOS D. If 10-foot lanes were used, there would be only a few feet of additional roadway width needed. To investigate how soon an additional left-turn lane would be needed, 2020 projections were analyzed. The results in Table 23 demonstrate that the proposed changes to US-95 are not expected to significantly affect the Government Way / Harrison Avenue intersection in 2020.

Table 23. Government Way / Harrison Avenue Performance in 2020

Intersection	Minor Street			US 95 or Major Street		
	v/c	Delay (sec)	LOS	v/c	Delay (sec)	LOS
2020 AM Volumes						
Government Way / Harrison Avenue						
Existing US-95 Configuration	0.75	19	B	0.60	11	B
Proposed US-95 Configuration	0.75	17	B	0.58	11	B
2020 PM Volumes						
Government Way / Harrison Avenue						
Existing US-95 Configuration	0.69	18	B	0.60	19	B
Proposed US-95 Configuration	0.79	19	B	0.61	19	B

Side Street Operations

In order to quantify the impact of access management between Walnut Avenue and Ironwood Drive, turning movement counts were conducted at each intersection along this section of US-95. These intersections include US-95 at Linden Avenue, Lacrosse Avenue, Mill Avenue, Davison Avenue, and Emma Avenue. Two peak hours were observed in the afternoon, with one likely related to the shift change at Kootenai Health and the other related to general work traffic.

Table 24 summarizes the amount of volume at each intersection that would be rerouted due to access management. The total volume on the corridor is calculated as the sum of the side street volumes plus the US-95 volume entering the corridor. Note that right turns from Lacrosse Avenue are considered acceptable in this analysis.

Table 24. Seasonally Adjusted Volume of Traffic Rerouted Due to Access Management

Intersection	AM Peak	PM Peak 1	PM Peak 2
Rerouted Volume			
Emma Avenue	51	105	113
Davidson Avenue	77	97	97
Mill Avenue	47	81	62
Lacrosse Avenue	60	62	-
Linden Avenue	51	95	66
Total Rerouted Volume	**286**	**440**	**338**
Total Corridor Volume	1374	1793	1641
Percent Volume Rerouted	**21%**	**25%**	**21%**

The number of vehicles impacted by access management does not by itself provide a complete description of the overall impact, as many vehicles may only be delayed by a few seconds. Therefore, a VISSIM microsimulation model was developed to compare travel times between existing and proposed cases. Microsimulation accounts for vehicle interactions at, in this instance, 0.1 second time steps. This resolution provides enough detail to assess the travel time of each vehicle.

The result of the microsimulation model showed that the average increase in travel time on side streets would be 8 seconds during the AM peak hour and 3 seconds during the PM peak hour. This includes data for all vehicles originating from or destined to a side street. Several vehicles would be delayed by 100 seconds due to the length of their new routes under access management. In the AM peak hour, only one vehicle would be delayed longer than 1 minute, while in the PM peak hour, 20 vehicles would be delayed longer than 1 minute.

Other Alternatives

Several alternatives currently being considered could impact operations on the Ironwood Segment if implemented. These are stand-alone alternatives and are not mutually exclusive. First, a warrants analysis will consider a signal at US-95 / Emma Avenue, which has been proposed to accommodate a development that is underway on Emma Avenue. Second, it is possible that Medina Street would be connected to Ironwood Drive, which could alter the traffic patterns in the vicinity. Finally, a right-turn bay has been proposed on eastbound Ironwood Drive at US-95, and the benefit of this added lane will be assessed.

Emma Avenue

A developer with property on Emma Avenue has inquired about a signal at US-95 / Emma Avenue due to the increased demand expected from development of the property. Since trip generation projections from the development are not available for this study, it will be useful to estimate the threshold at which traffic volumes at US-95 / Emma Avenue would warrant a signal. Note that even if a signal is warranted, the proximity of the signal at US-95 / Ironwood Drive may make it difficult to operate a signal at US-95 / Emma Avenue effectively.

Existing turning movement counts at US-95/Emma Avenue provided four hours of data in the afternoon. For the purpose of warrants analysis, this data collection period can be assumed to be the peak four hours of the day. Signal warrants consider an average day, and the turning movement counts were assumed to represent an average day and were not seasonally adjusted. This is justified by the counts being taken in October, when average daily traffic is 99% of the annual average, according to the automatic traffic recorder at Haycraft Avenue. ITD uses the following eight signal warrants to assess whether a signal is justified:

- Warrant 1—Eight-hour vehicular volume
- Warrant 2—Four-hour vehicular volume
- Warrant 3—Peak-hour vehicular volume
- Warrant 4—Pedestrian volume
- Warrant 5—School crossing
- Warrant 6—Coordinated signal system
- Warrant 7—Crash experience
- Warrant 8—Roadway network

The four hours of data that were collected all met Warrant 1, although additional data would be necessary to complete this warrant. Warrant 2 is not met with the observed traffic volumes but would be met by a 30% increase in volume on Emma Avenue. For Warrant 3, Option A is not met, because HCS 2010 indicates 0.6 vehicle-hours of delay on the eastbound approach. Option B is not met by the existing counts and could only be met if peak-hour traffic on Emma Avenue doubled to about 225 vehicles per hour. Warrants 4 and 5 are not met because there were fewer than 20 pedestrians who crossed US-95 during any given hour. The signal at Ironwood Drive achieves platooning for northbound US-95, and it is

assumed this platooning is sufficient for signal progression. Therefore, Warrant 6 would not be met. The crash rate is less than 5 per year, and thus Warrant 7 is not met. Warrant 8 requires a projected intersection peak-hour volume greater than 1,000 vehicles per hour, which occurs already, and requires Warrants 1, 2, and 3 be projected to be met within the next 5 years.

To meet Warrant 2 traffic on Emma would need to be 120 vehicles per hour. In order to meet Warrant 3, peak-hour traffic would need to increase by 220 vehicles on the eastbound approach. In all, Warrants 1 and 8 might currently be met if there were adequate data to support them. Warrants 2 and 3 are possible in the future with a large enough development on Emma Avenue.

Medina Street Connection

A possible extension of Medina Street to Ironwood Drive would significantly alter traffic patterns on the west side of US-95 and, to a lesser extent, on US-95 itself. When Medina Street is connected to Ironwood Drive in the existing KMPO model, traffic uses Medina Street and Emma Avenue to avoid the US-95 / Ironwood Drive intersection. This also is true with access management in place along US-95. Table 25 shows the amount of change in traffic volumes with respect to the existing model.

Table 25. Change in Traffic Patterns with Medina Street Connection

Intersection	Medina Connection	Medina Connection with Signal at US-95 / Emma	Medina Connection with Access Management
2010 PM Volumes			
US-95 / Ironwood Drive			
Eastbound	-20%	0%	-15%
Northbound	-20%	5%	-20%
US-95 / Emma Avenue			
Eastbound	15%	15%	-5%

With access management on US-95, access to northbound US-95 would be difficult for the neighborhood to the west of US-95. The Medina Street connection could improve the access management scenario by providing a northbound route that some users may prefer over a U-turn route on US-95.

Ironwood Drive Right Turn Bay

The City of Coeur d'Alene is currently considering whether to install a designated right-turn lane on the eastbound approach of the US-95 / Ironwood Drive intersection. This would provide RTOR access for right-turning vehicles and would reduce the queue length for through and left-turning vehicles.

Turning movement counts were conducted on the eastbound Ironwood Drive approach to determine the proportion of traffic turning right. This proportion (10% in the PM peak hour) was then applied to the KMPO model, which was used to estimate the turning movement volumes on all approaches. The intersection was modeled in Synchro, and results were analyzed according to HCM 2010 methodology. Signal timing parameters were set in Synchro to match existing timing parameters except for the split times, which were optimized in the software because modeled turning movement counts may not match actual volumes in the field. The existing signal is coordinated with other signals but could not be modeled as such due to the complexity of the system. Coordination would tend to improve performance on the southbound approach, while its effect on Ironwood Drive

could be positive (if the southbound green time is shorter) or negative (if southbound green is extended with no vehicles present).

Table 26 shows slight improvements to the overall intersection, with the primary improvement on the eastbound right turn, which improves from LOS E to A. This benefits the 73 vehicles observed turning right in the peak hour, or a seasonally adjusted 83 vehicles. One of the other noticeable benefits is to the queue length on the eastbound approach, where queues often conflict with Kootenai Health driveways. The 95th-percentile queue length decreased by 85 feet for the eastbound through and left-turn movements.

Table 26. US-95 / Ironwood Drive Intersection Performance with an EBR Turn Lane

		Ironwood EBT/L	Ironwood EBR	US 95
2010 PM Volumes				
Existing Configuration	**Queue* (ft)**	730	629	545
	v/c	0.96	0.95	1.03
	Delay (sec)	89	74	112
	LOS	F	E	F
With EBR Turn Lane	**Queue* (ft)**	645	42	518
	v/c	0.93	0.25	0.97
	Delay (sec)	86	6	98
	LOS	F	A	F

**95th-percentile Queue Length*

Recommendations and Implementation Plan

This report made the following recommendations for the Spokane River Crossing Segment and Ironwood Segment:

- Create a single access point on Blackwell Island that would eliminate all existing access points from Upriver Drive to the Spokane River Bridge. This option could be a diamond interchange or a signalized intersection. Fairmont Loop would be realigned and would require a bridge over Blackwell Slough. An extension of Lakeview Drive to Fairmont Loop would require right-of-way acquisition of several houses. In addition, Blackwell Mill Road would need to cross under US-95 to connect with Lakeview Drive.
- Widen US-95 to four lanes on the Spokane River Crossing Segment and eventually from the Spokane River Bridge to Walnut Avenue. This would require a new Blackwell Slough Bridge and a new Spokane River Bridge.
- Reconfigure the Walnut Avenue intersection by eliminating access to Walnut Avenue and Lincoln Way, except for right turn access to Lincoln Way from northbound US-95. Northbound US-95 would be realigned to follow alongside the existing southbound curve.
- Manage access to cross streets between Walnut Avenue and Ironwood Drive. Left turns onto the highway would be prohibited. Left turns onto the cross streets would be allowed at Lacrosse, Mill (southbound only), and Emma Avenues. Right-in, right-out access would be allowed at all cross streets except Linden Avenue, which would be blocked off.
- A signal at US-95/Emma Avenue is not warranted with available data. If a signal were to be warranted in the future, its impact on the coordinated signal system would need to be studied.

- Extending Medina Street to Ironwood Drive would improve connectivity to the neighborhood west of US-95 and would reduce the possible need for a signal at US-95 / Emma Avenue.
- An eastbound right-turn bay at US-95 / Ironwood Drive would mainly benefit the right-turn movement and would also provide a minor benefit to operations on US-95.

5 YEAR IMPROVEMENTS (ON OR BEFORE 2020)

The Spokane River Crossing Segment is currently operating at LOS E, below the acceptable standard. It should be noted that LOS on two-lane highways is measured by percent time spent following, and on a two-lane segment that is just over a mile long, most vehicles do not spend a substantial amount of time following before they reach an adjacent four-lane segment. On the other hand, it does not operate at an acceptable performance level and is the only operationally deficient segment in the vicinity (outside of the signalized urban corridor through Coeur d'Alene). Since the operational performance is currently deficient, selection of a preferred Scenario is recommended for planning and design within the next 5 years, with construction to begin as soon as possible. This would include reconstruction of the Blackwell Slough Bridge and Spokane River Bridge to expand them to four lanes.

On the Ironwood Segment, the existing US-95 / Lincoln Way / Walnut Avenue intersection currently operates at an acceptable LOS but is expected to reach LOS F by 2020. Improvements are recommended within the next 5 years to avoid operational failure. Scenario 5d is recommended now due to its low cost and negligible right-of-way needs.

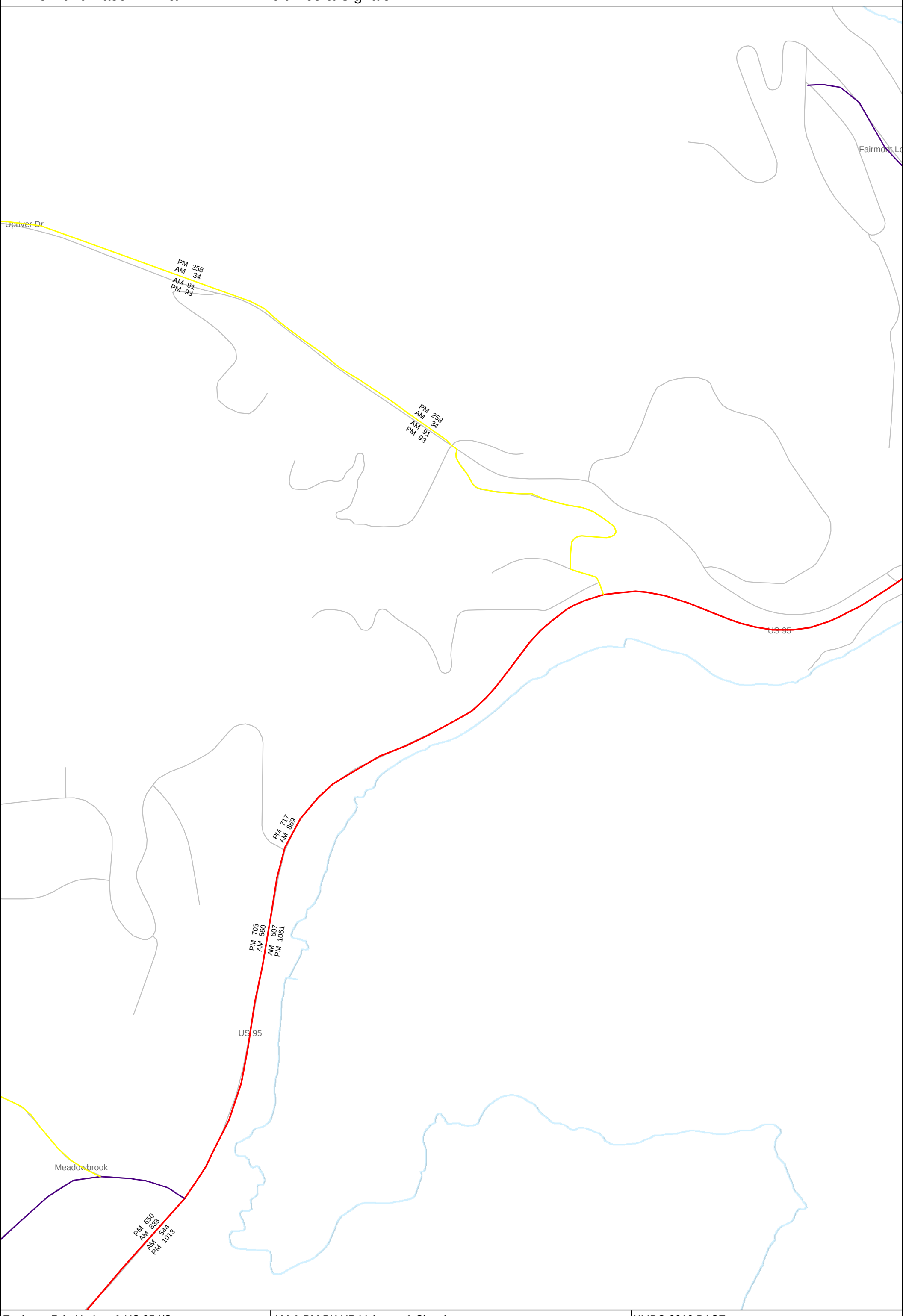
The 2003 study recommended turn restrictions on the Ironwood Segment between Walnut Avenue and Ironwood Drive. Since the TWSC intersections on the cross streets are expected to reach at least LOS E by 2020, these turn restrictions should be installed within the next 5 years.

10 YEAR IMPROVEMENTS (BEYOND 2020)

Most of the recommendations in this report are needed within the next 5 years due to current operational deficiencies; however, the Government Way / Harrison Avenue intersection operates acceptably with 2020 projections but not with 2035 projections. A second eastbound left-turn lane is expected to be necessary as intersection operations deteriorate due to increased left-turn demand.

Appendix A: KMPO PROJECTIONS

KMPO 2010 Base - AM & PM PK HR Volumes & Signals



Espinazo Rd - Upriver & US 95 I/S	AM & PM PK HR Volumes & Signals	KMPO 2010 BASE
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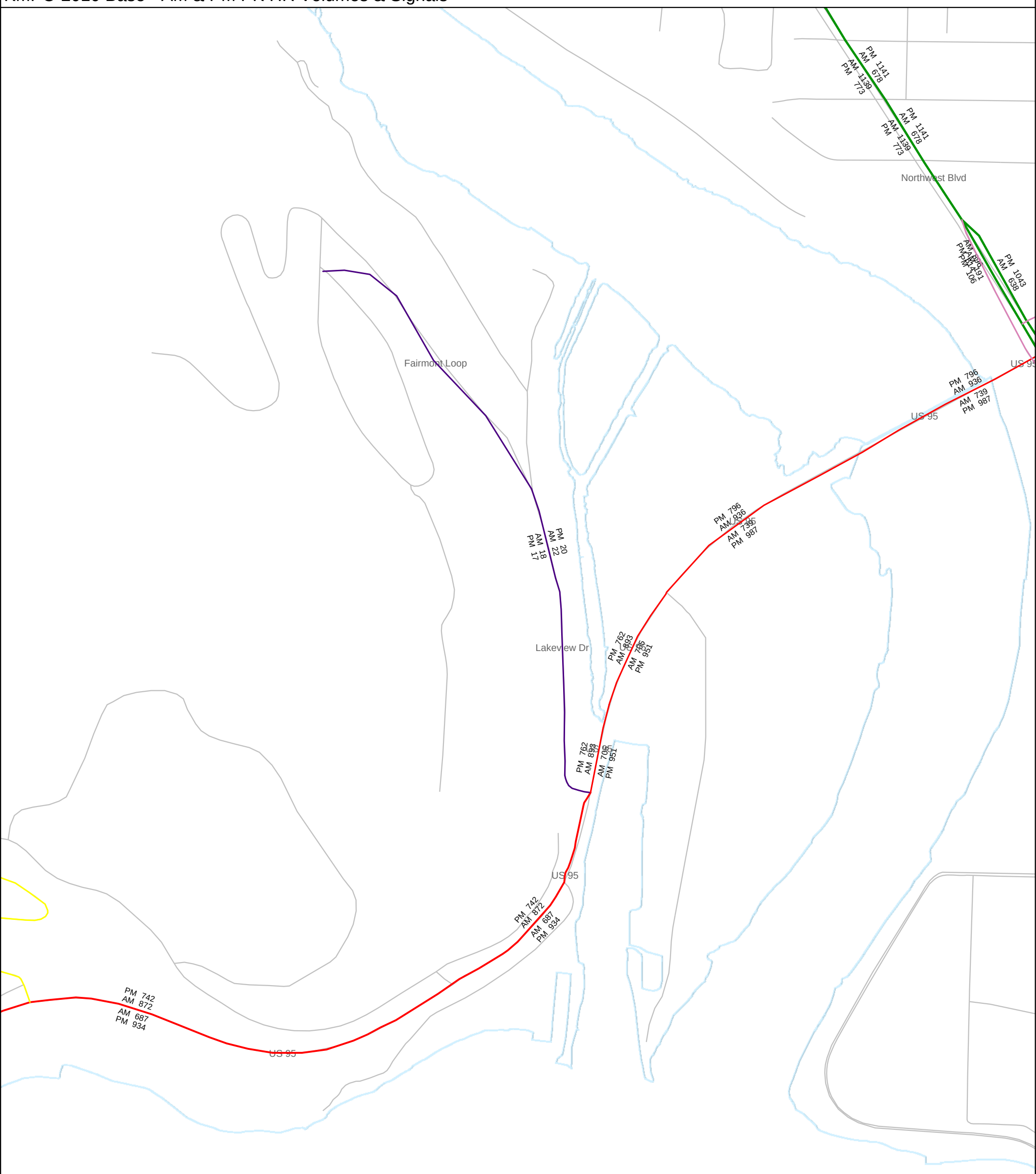
KMPO 2010 Base - AM & PM PK HR Volumes & Signals



Lakeview/Fairmont & US 95 I/S	AM & PM PK HR Volumes & Signals	KMPO 2010 BASE
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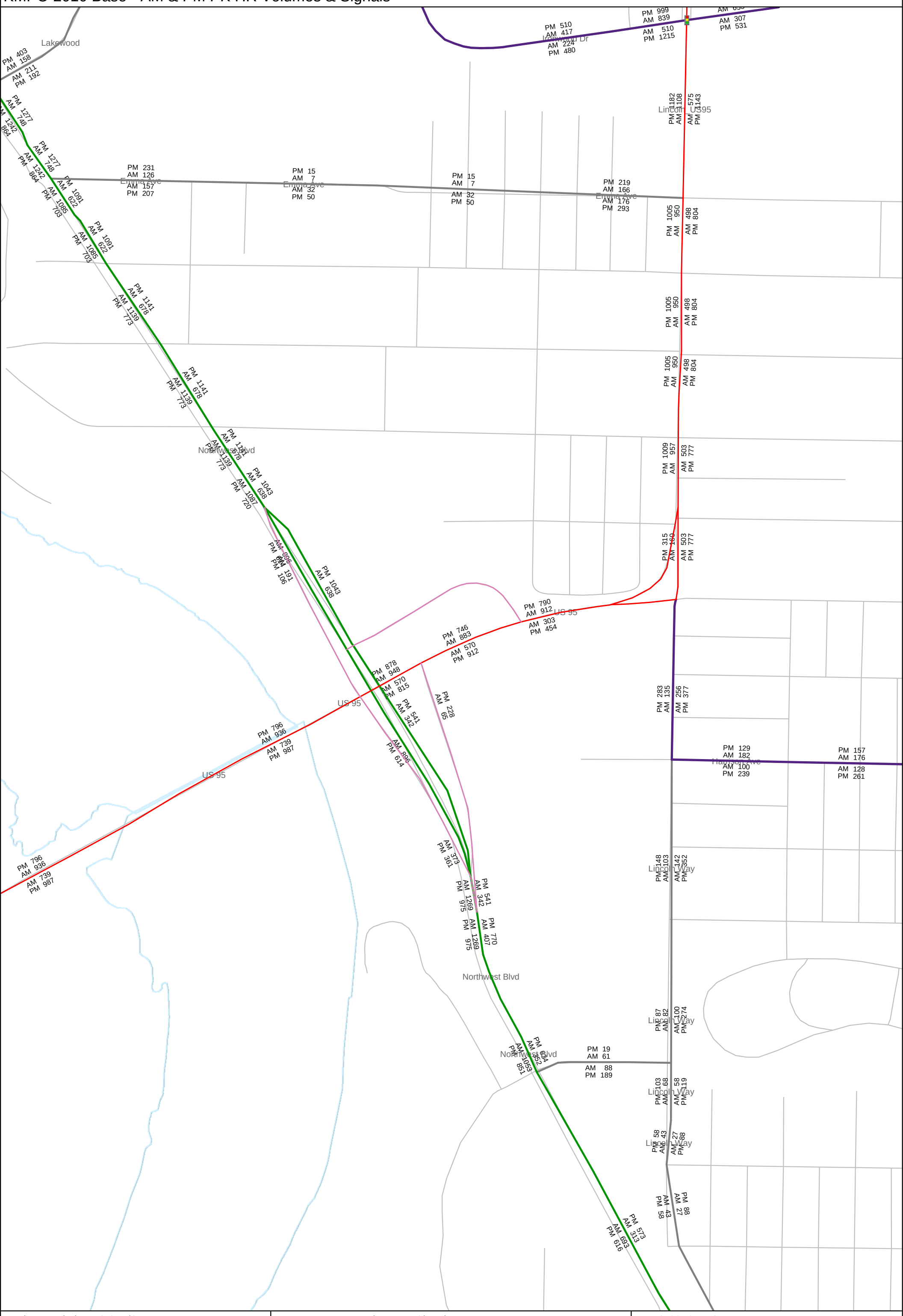
KMPO 2010 Base - AM & PM PK HR Volumes & Signals



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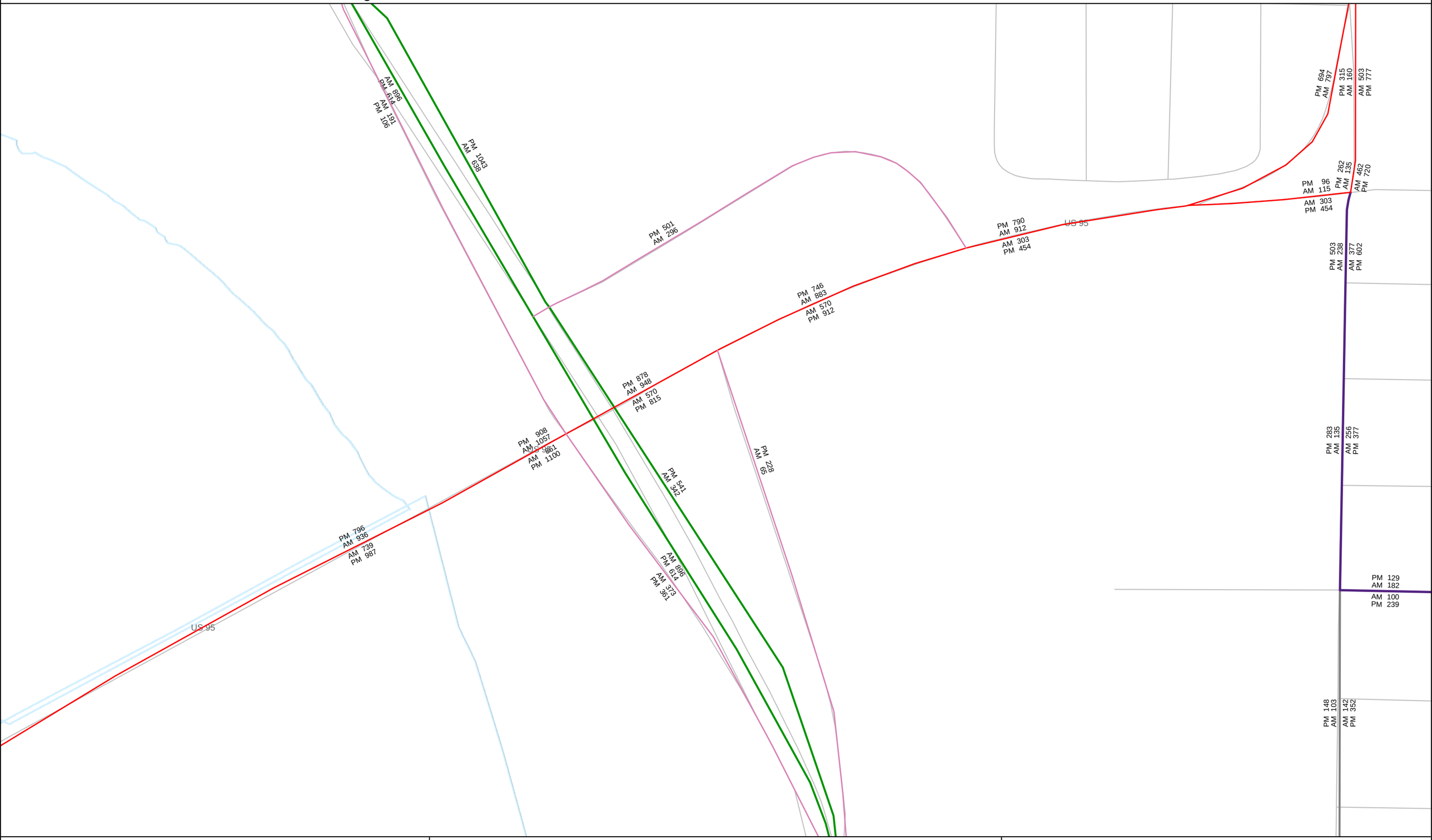
KMPO 2010 Base - AM & PM PK HR Volumes & Signals



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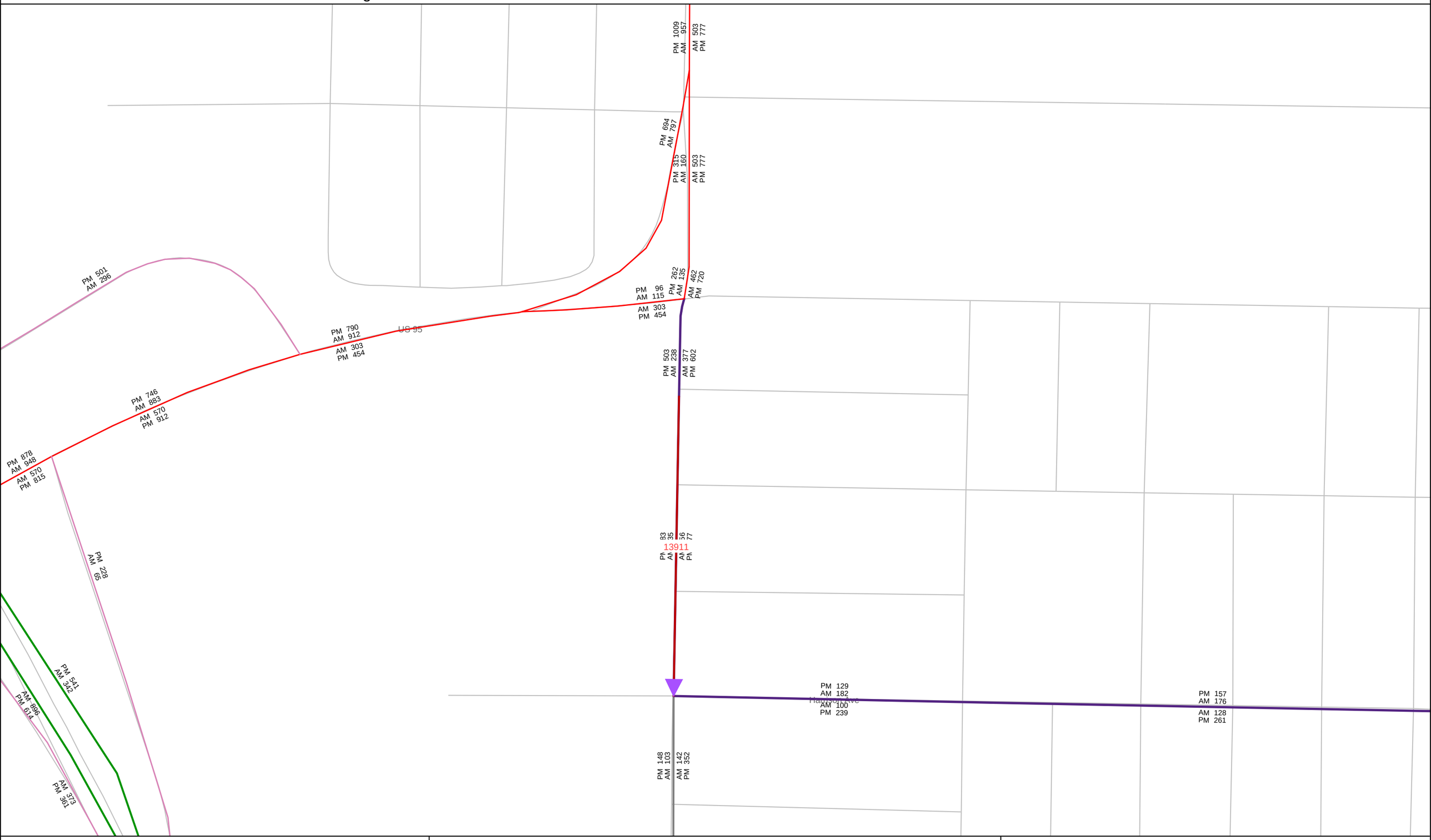
KMPO 2010 Base - AM & PM PK HR Volumes & Signals



US 95 - Lincoln - Harrison	AM & PM PK HR Volumes & Signals	KMPO 2010 BASE
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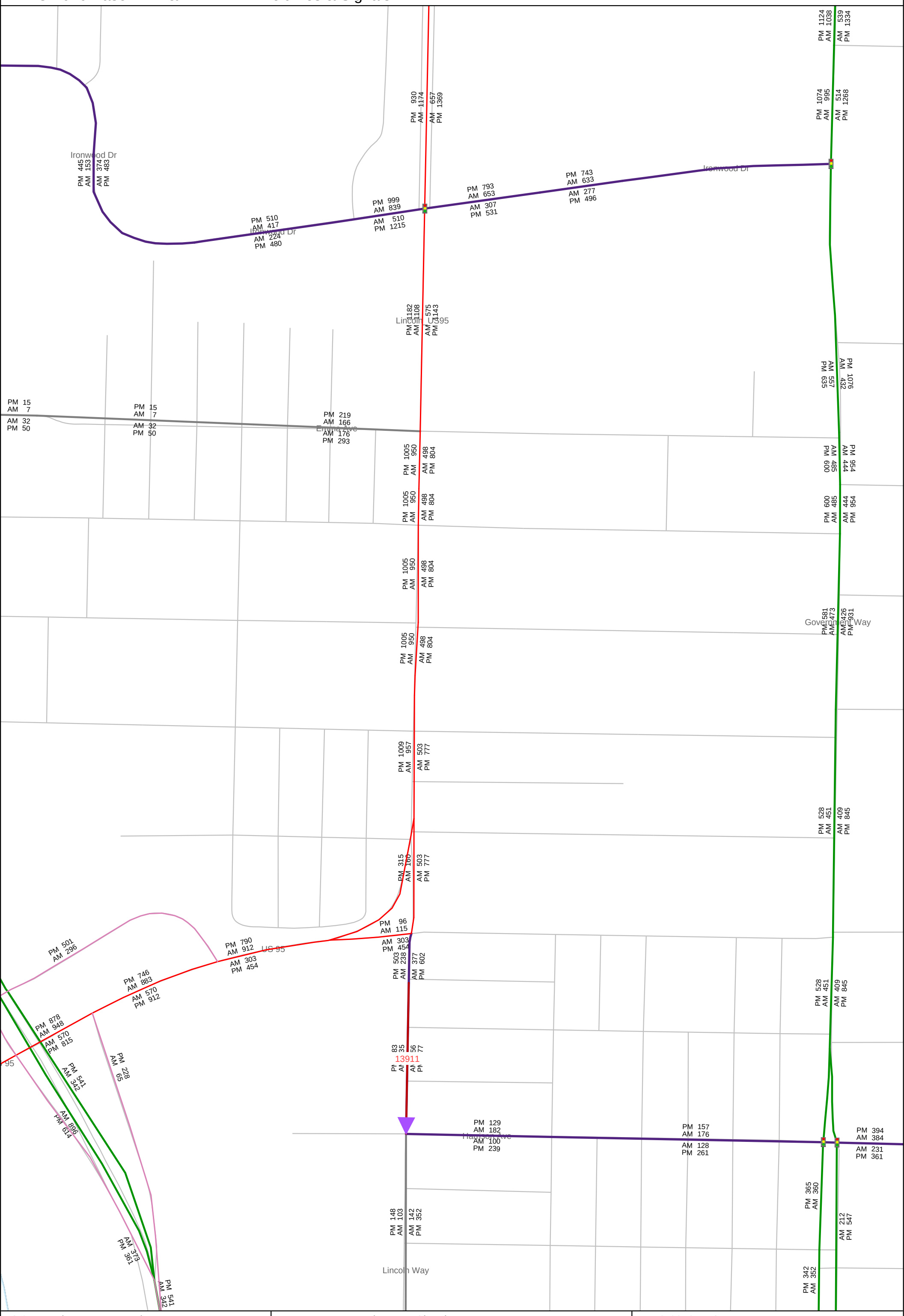
KMPO 2010 Base - AM & PM PK HR Volumes & Signals



US 95 -Harrison to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2010 BASE
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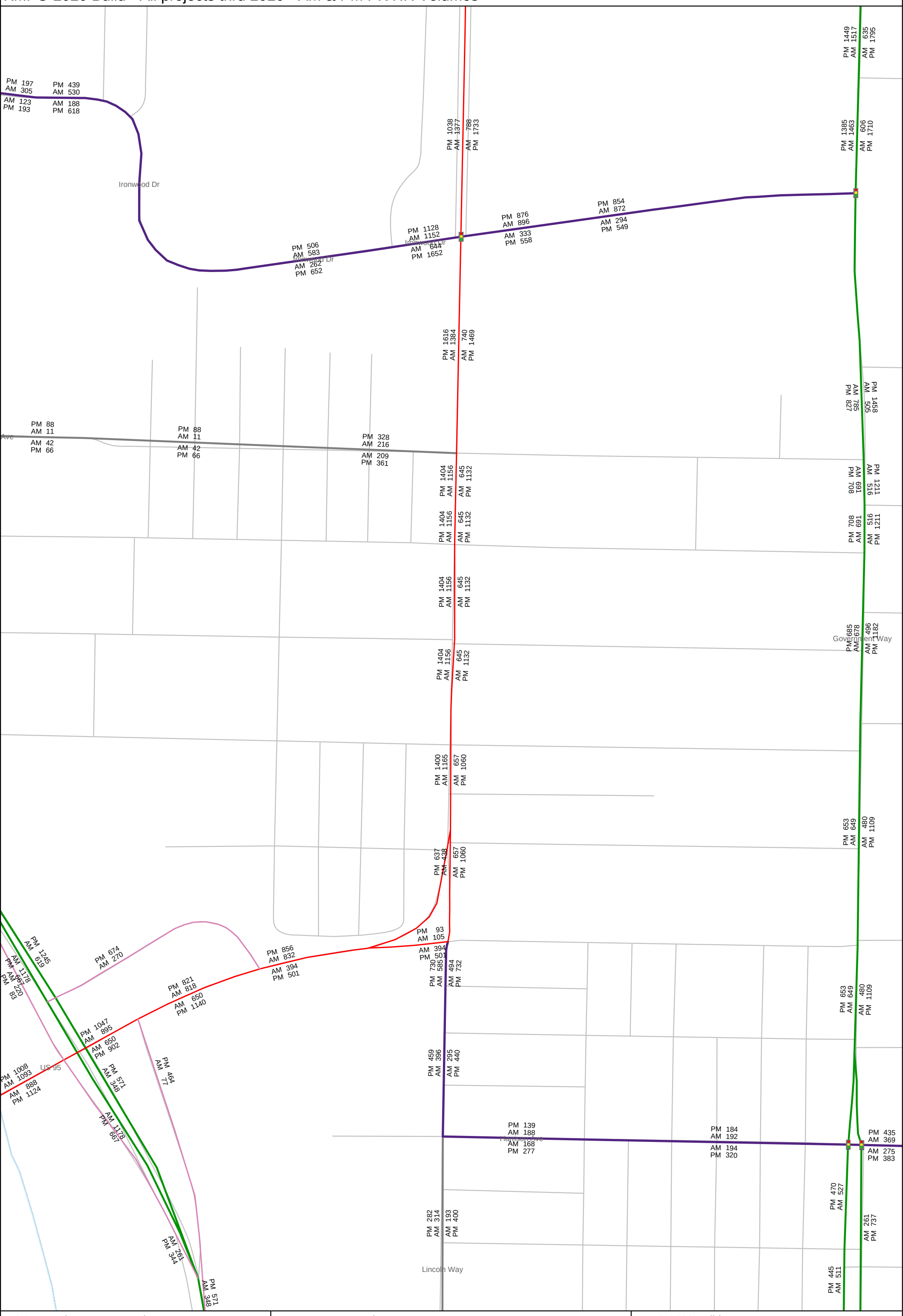
KMPO 2020 Build - All projects thru 2020 - AM & PM PK HR Volumes



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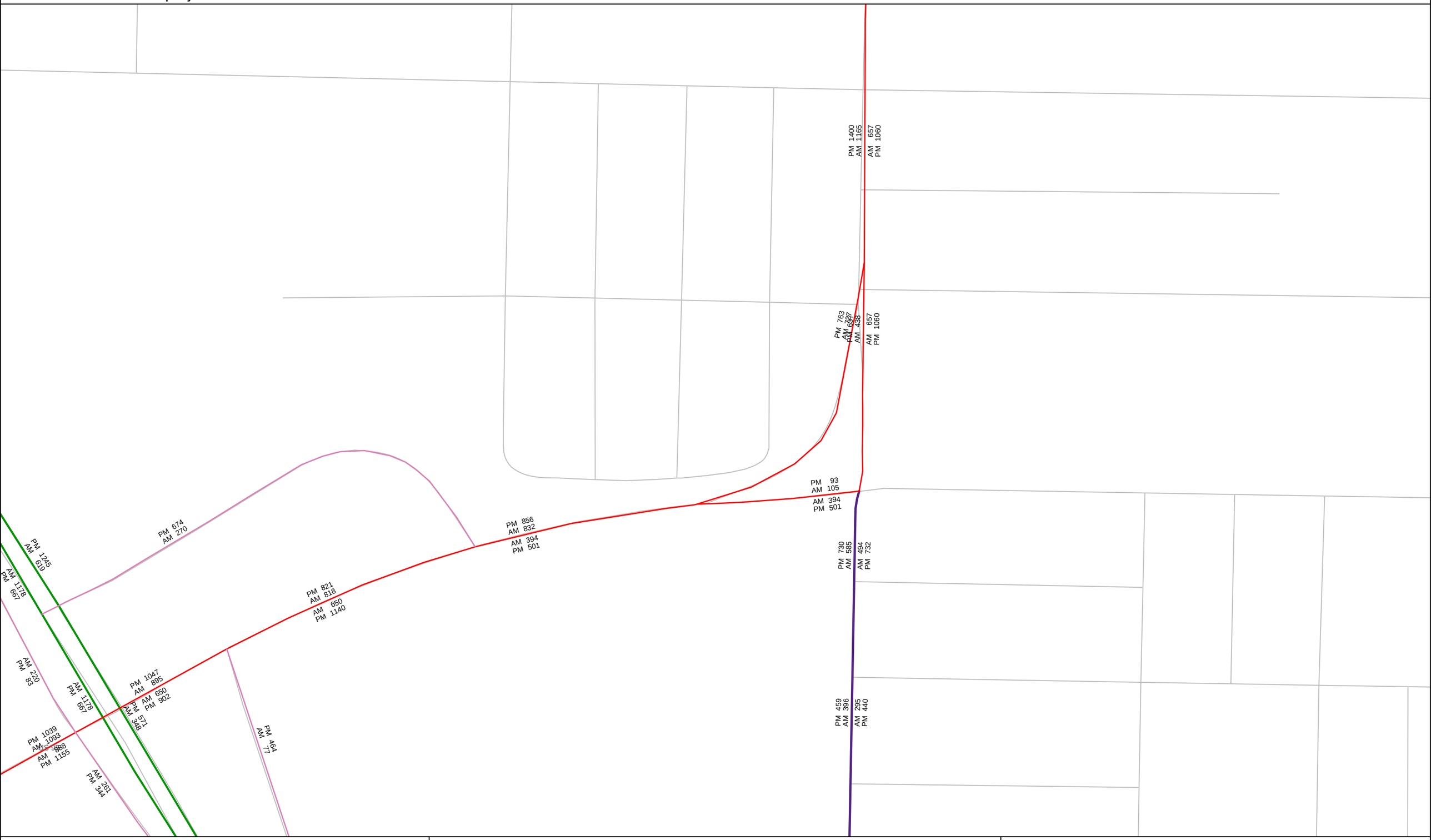

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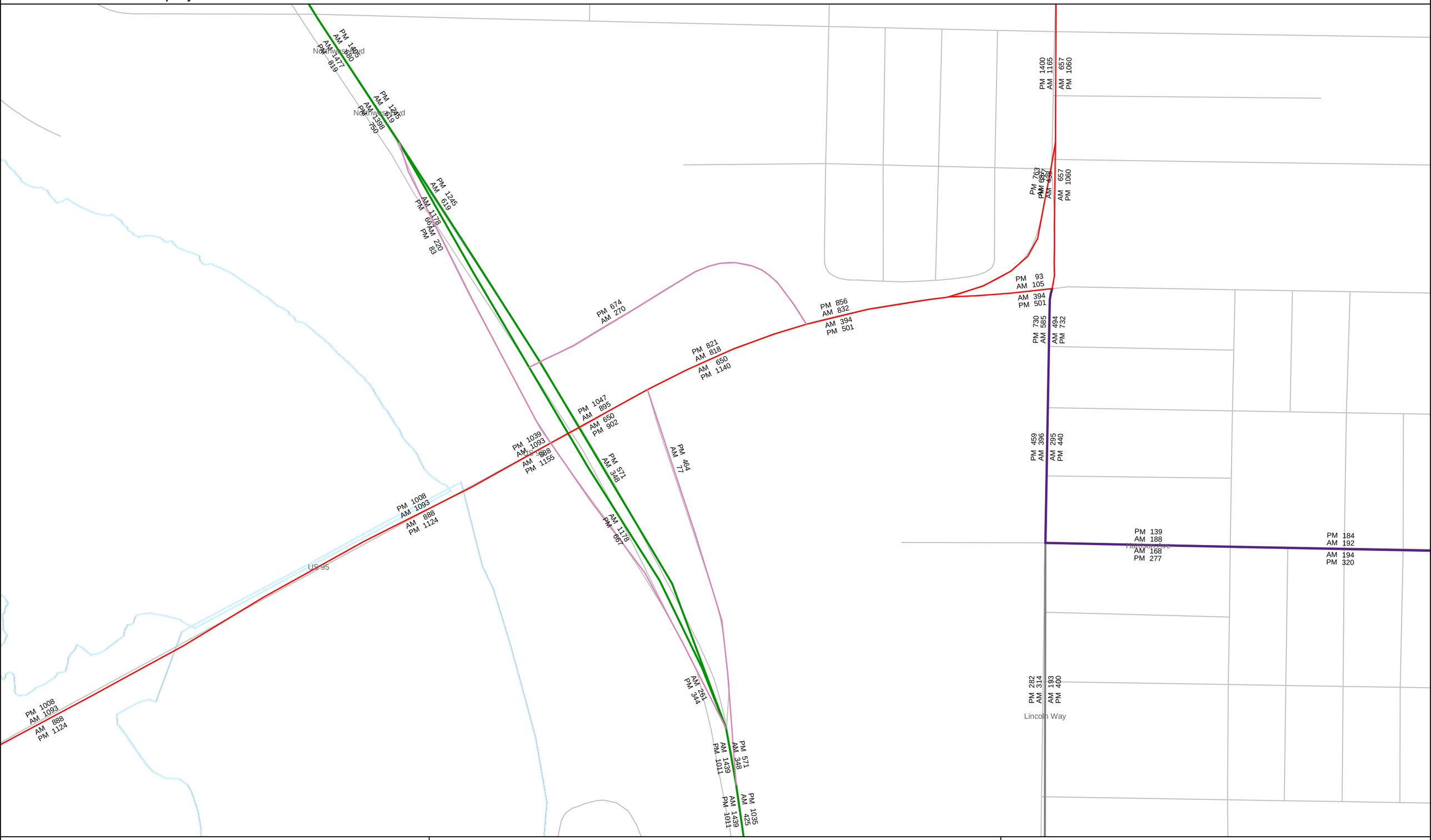

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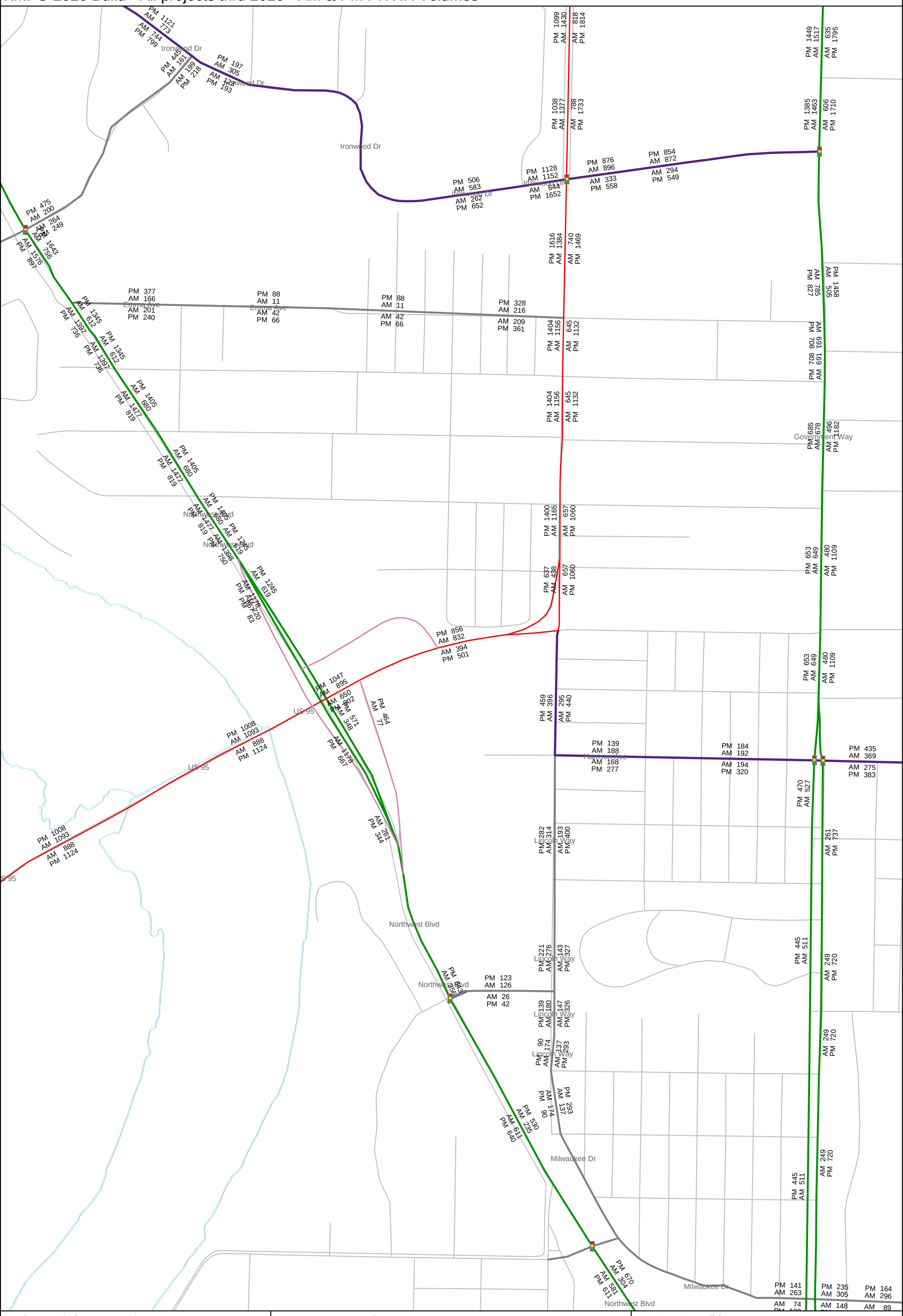

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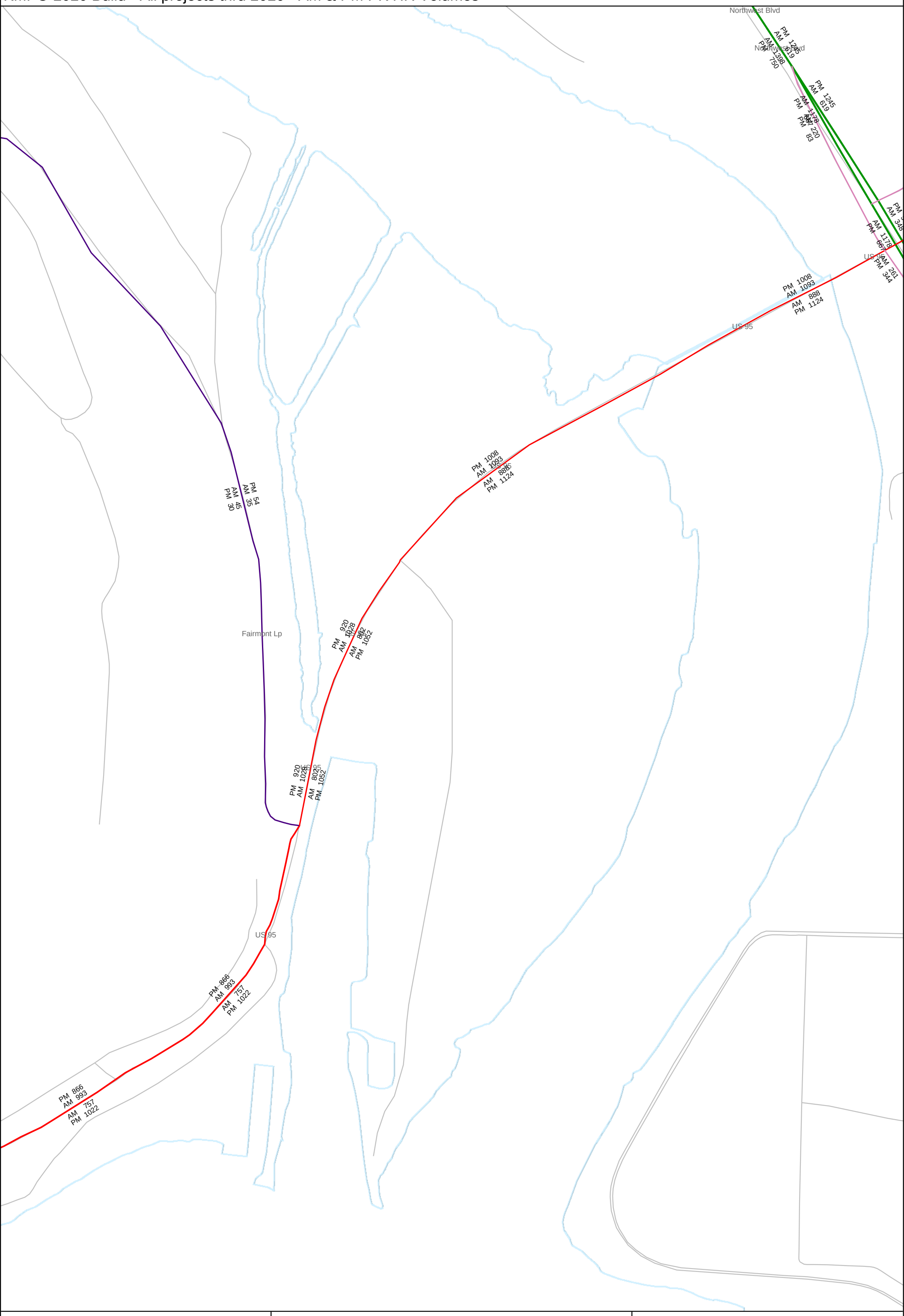

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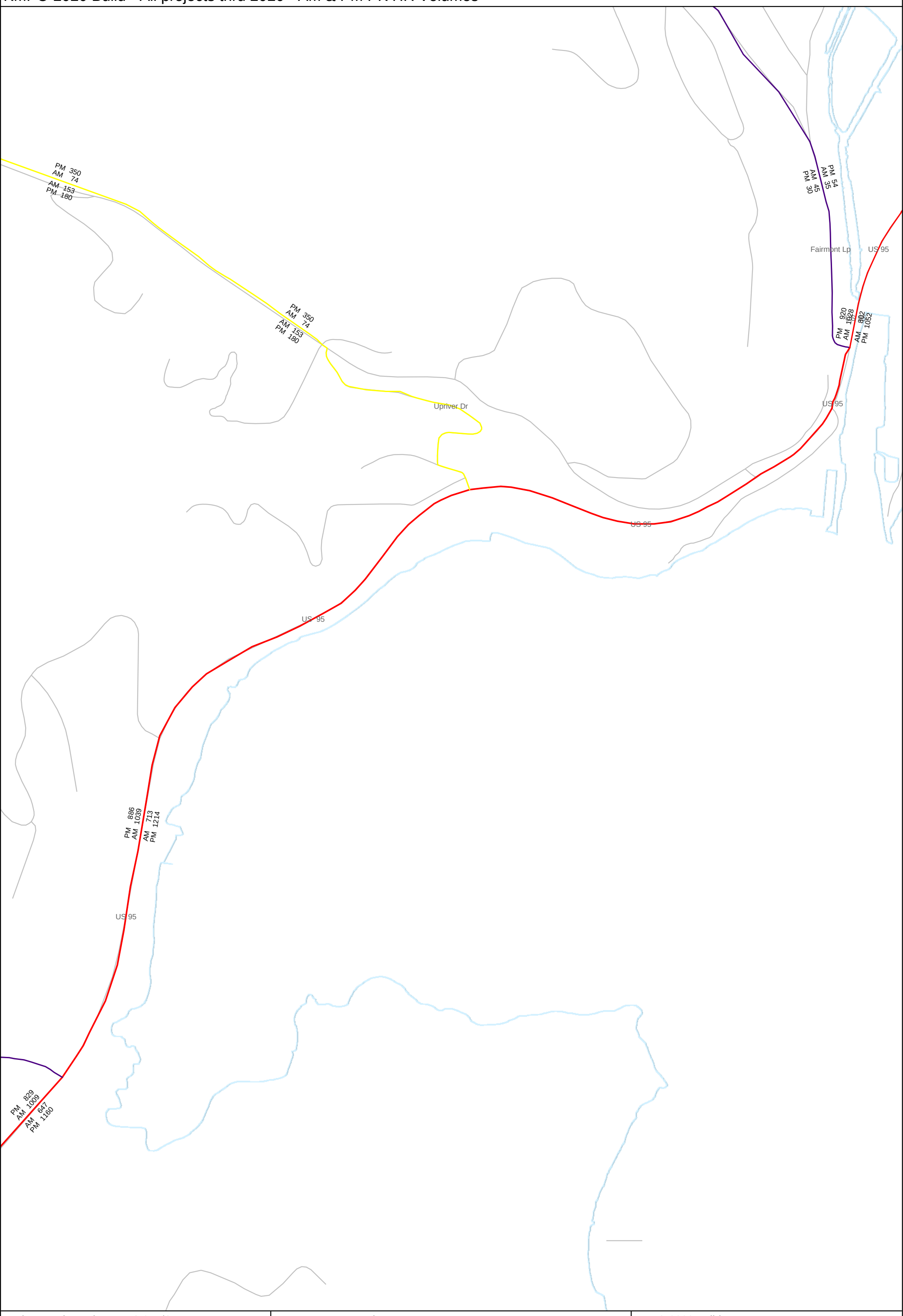
KMPO 2020 Build - All projects thru 2020 - AM & PM PK HR Volumes



Espinoza Rd - Upriver & US 95 I/S	AM & PM PK HR Volumes	KMPO 2020 Build
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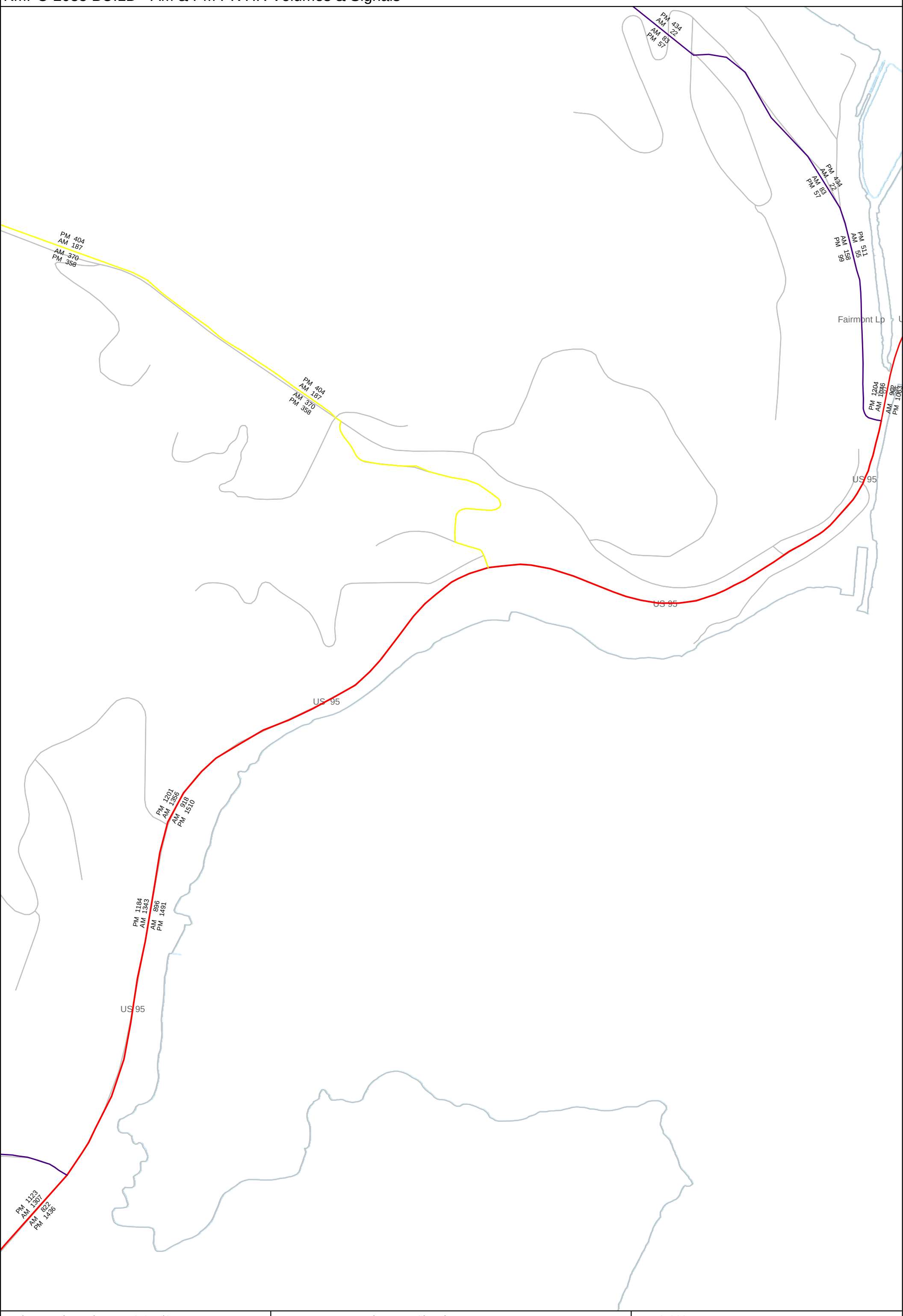
KMPO 2035 BUILD - AM & PM PK HR Volumes & Signals



Espinoza Rd - Upriver & US 95 I/S	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
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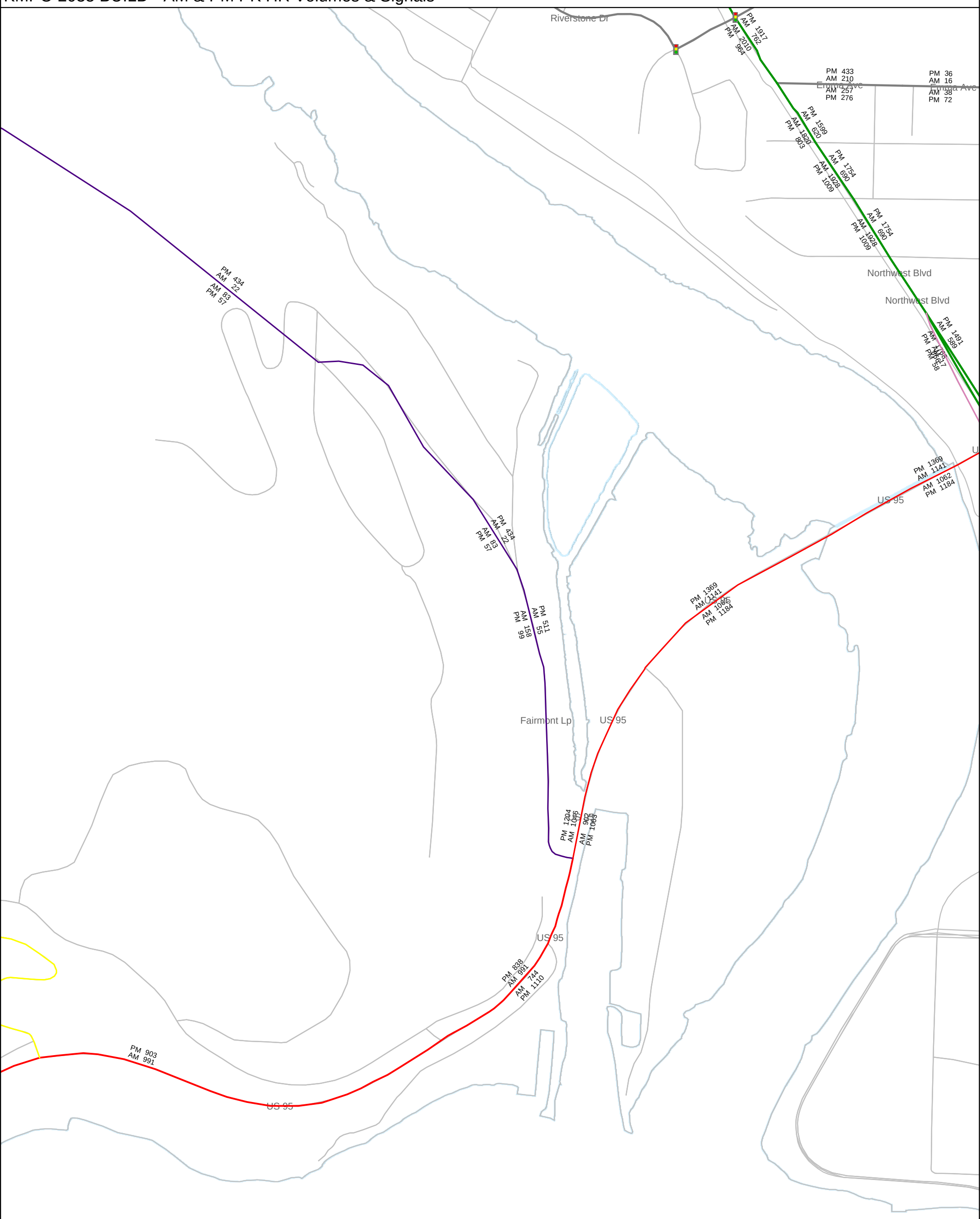
KMPO 2035 BUILD - AM & PM PK HR Volumes & Signals



Lakeview/Fairmont & US 95 I/S	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
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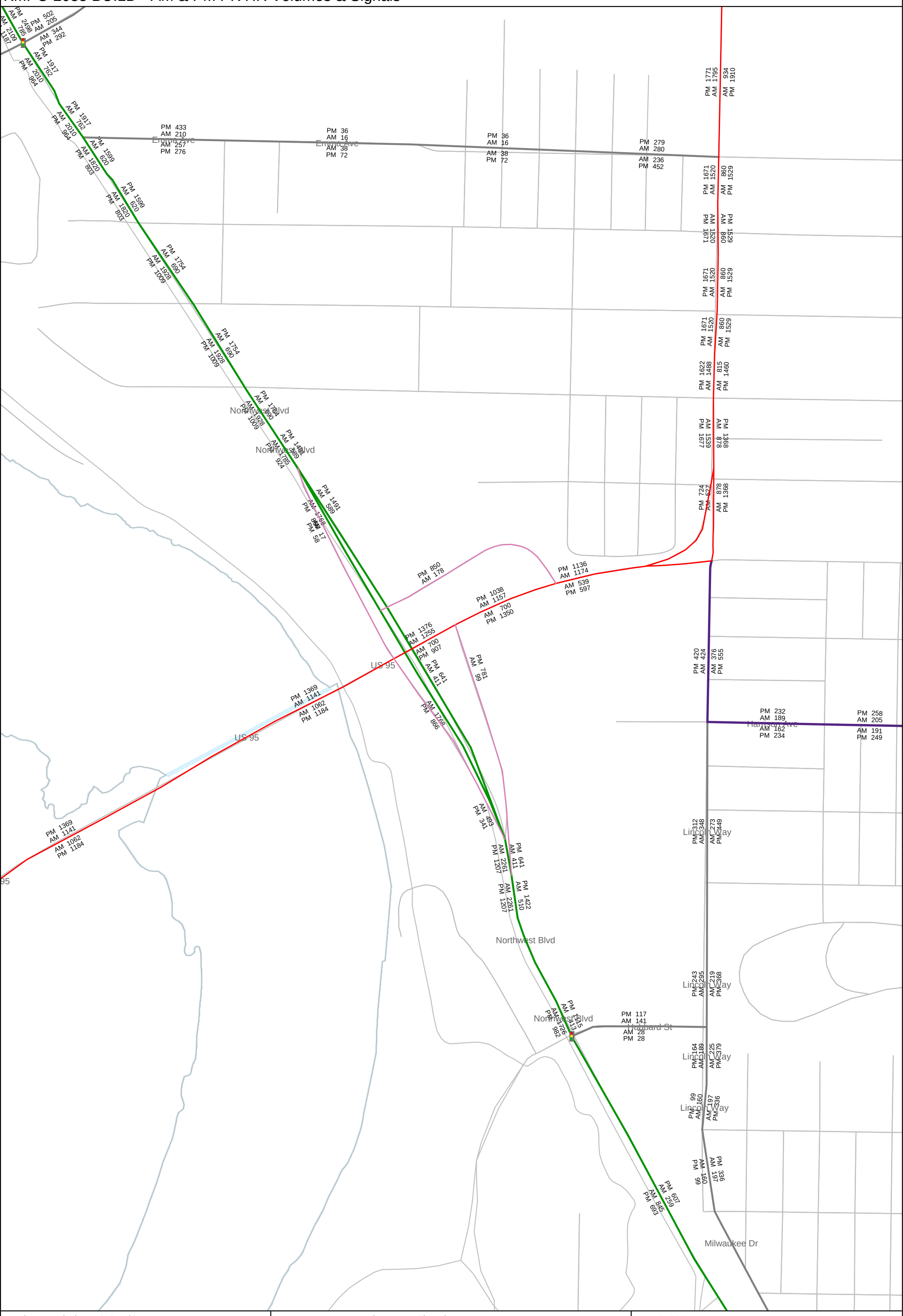

Northwest Blvd & US 95 I/S	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
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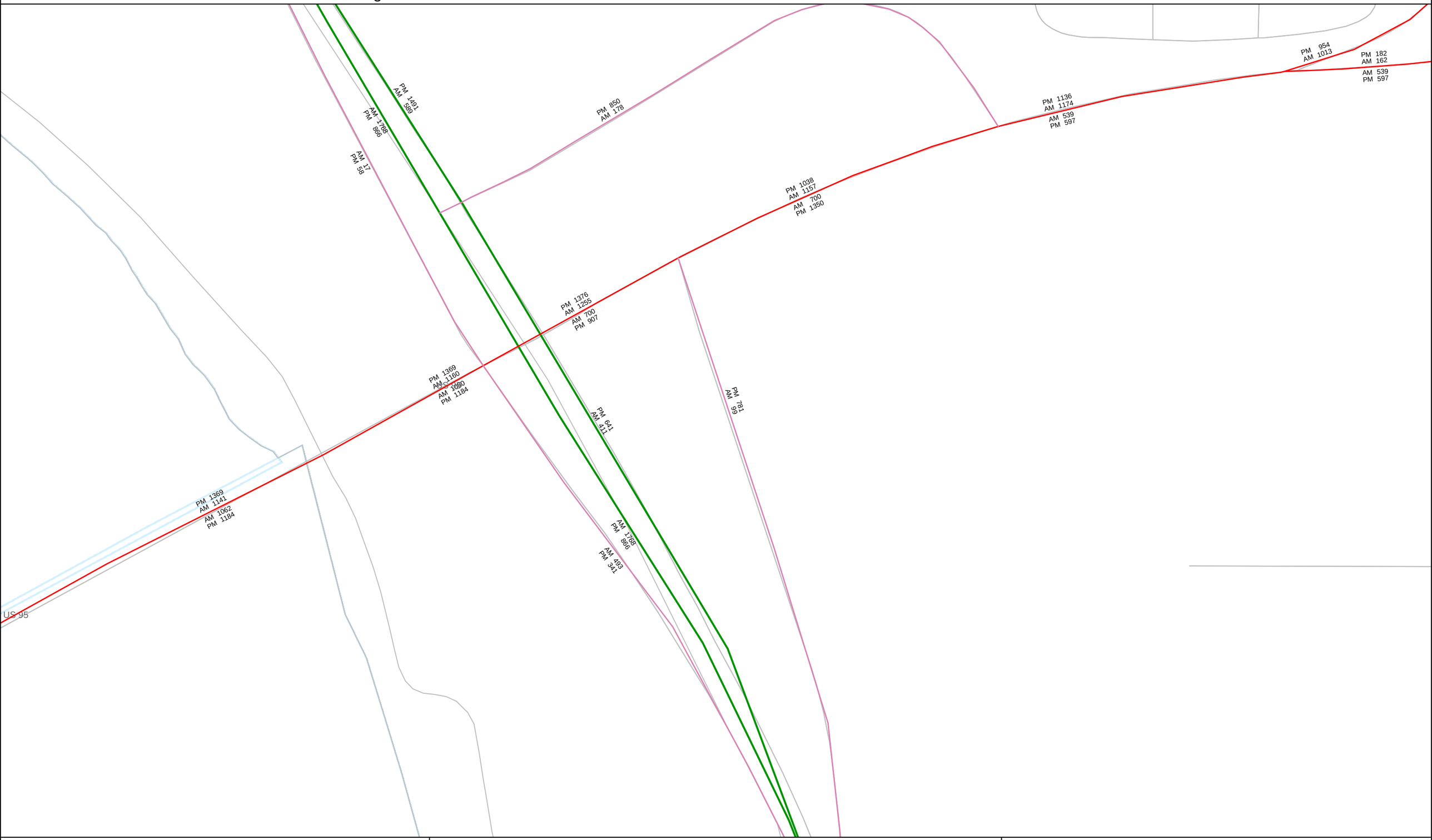

Northwest Blvd & US 95 Close-up I/S	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
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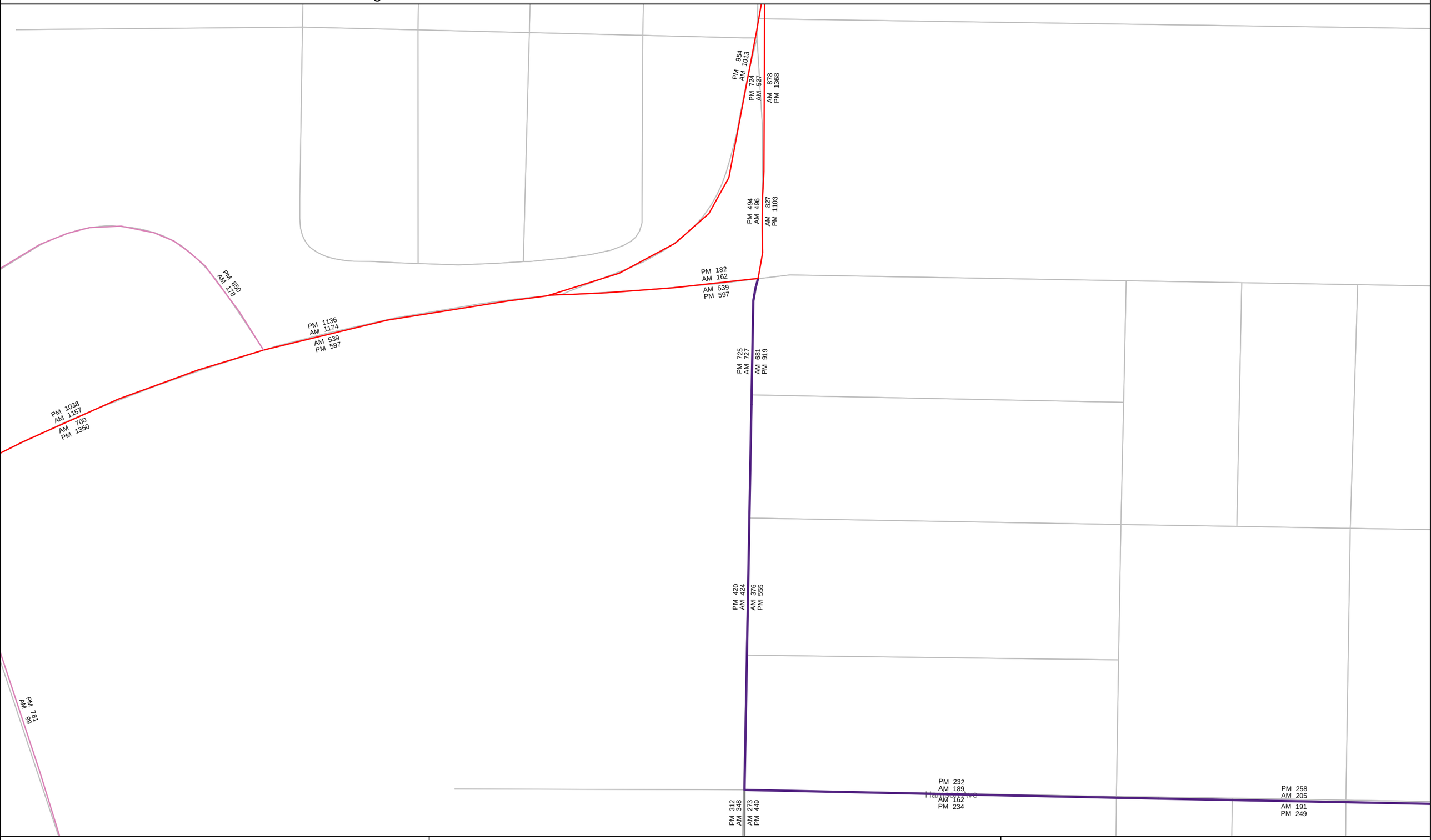

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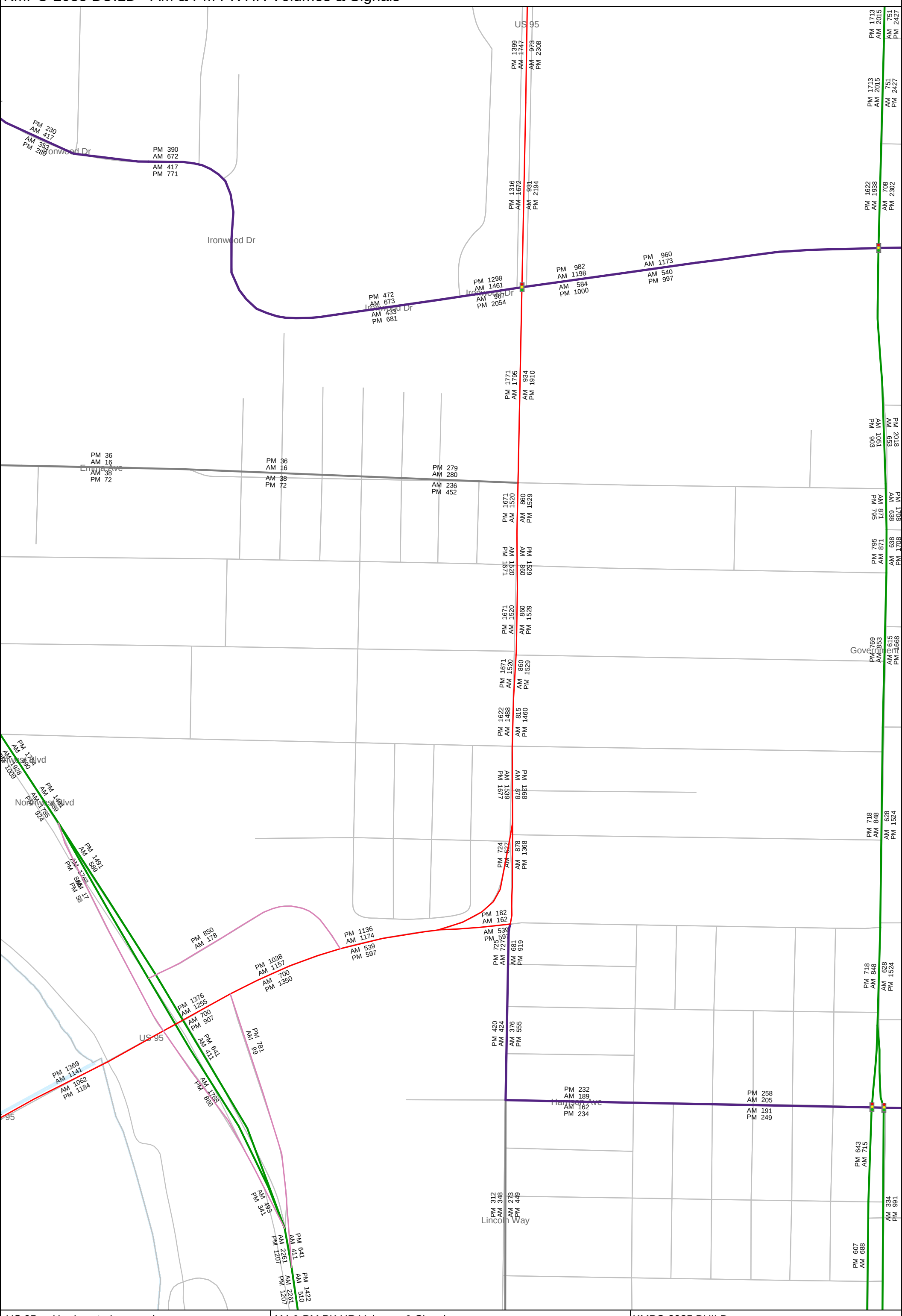

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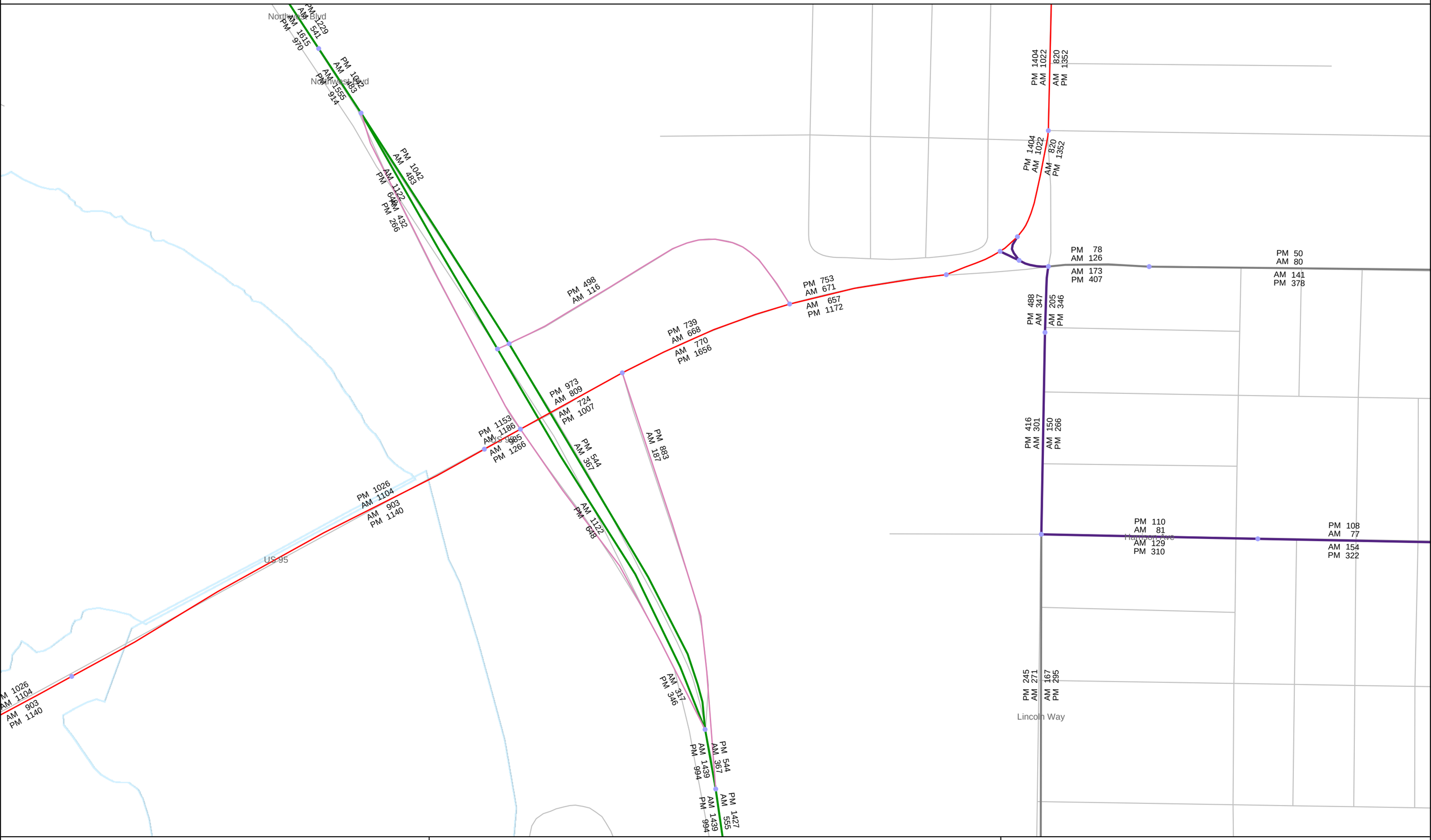

Northwest Blvd I/C & US 95	AM & PM PK HR Volumes	KMPO 2020 Build
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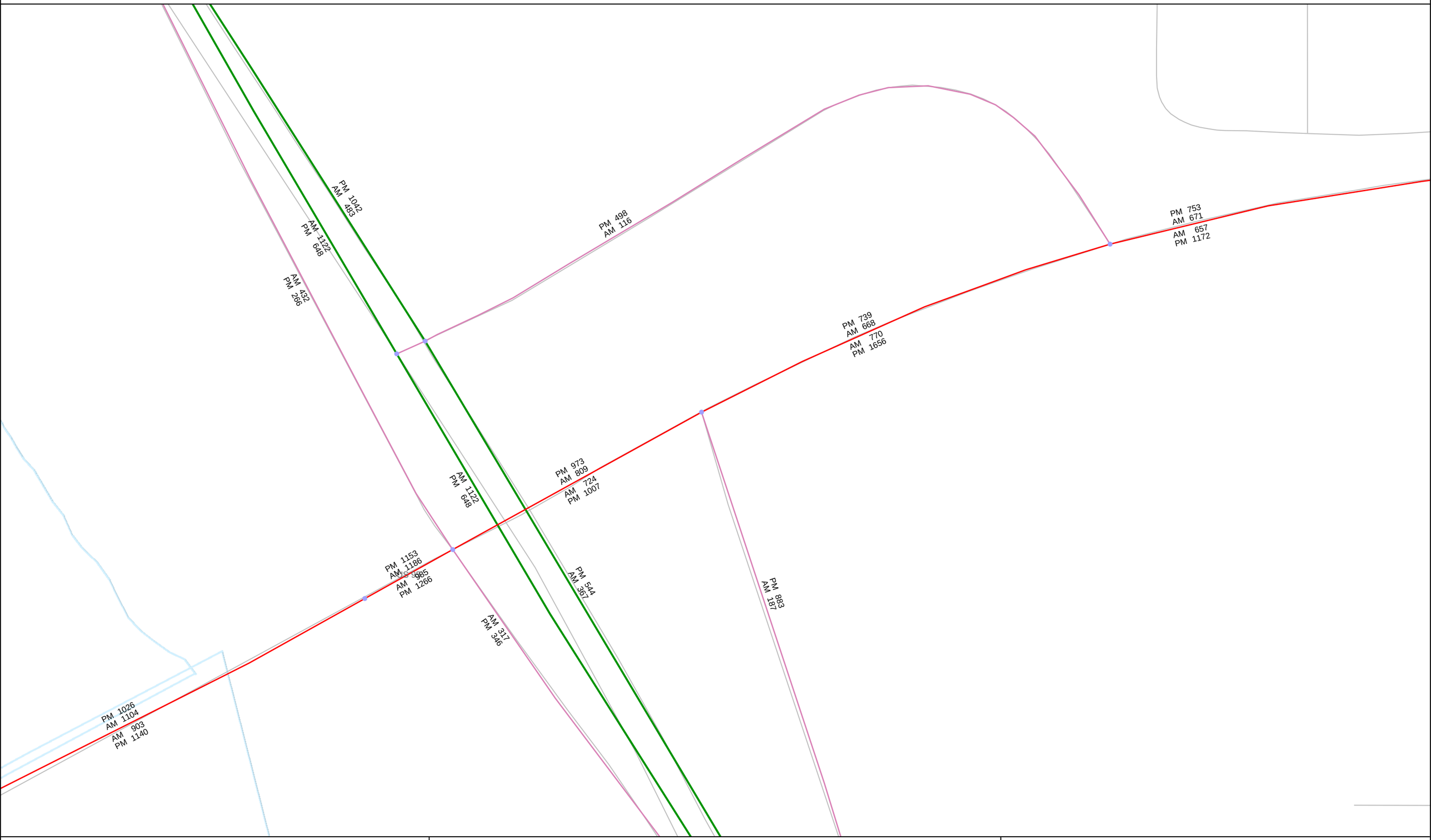

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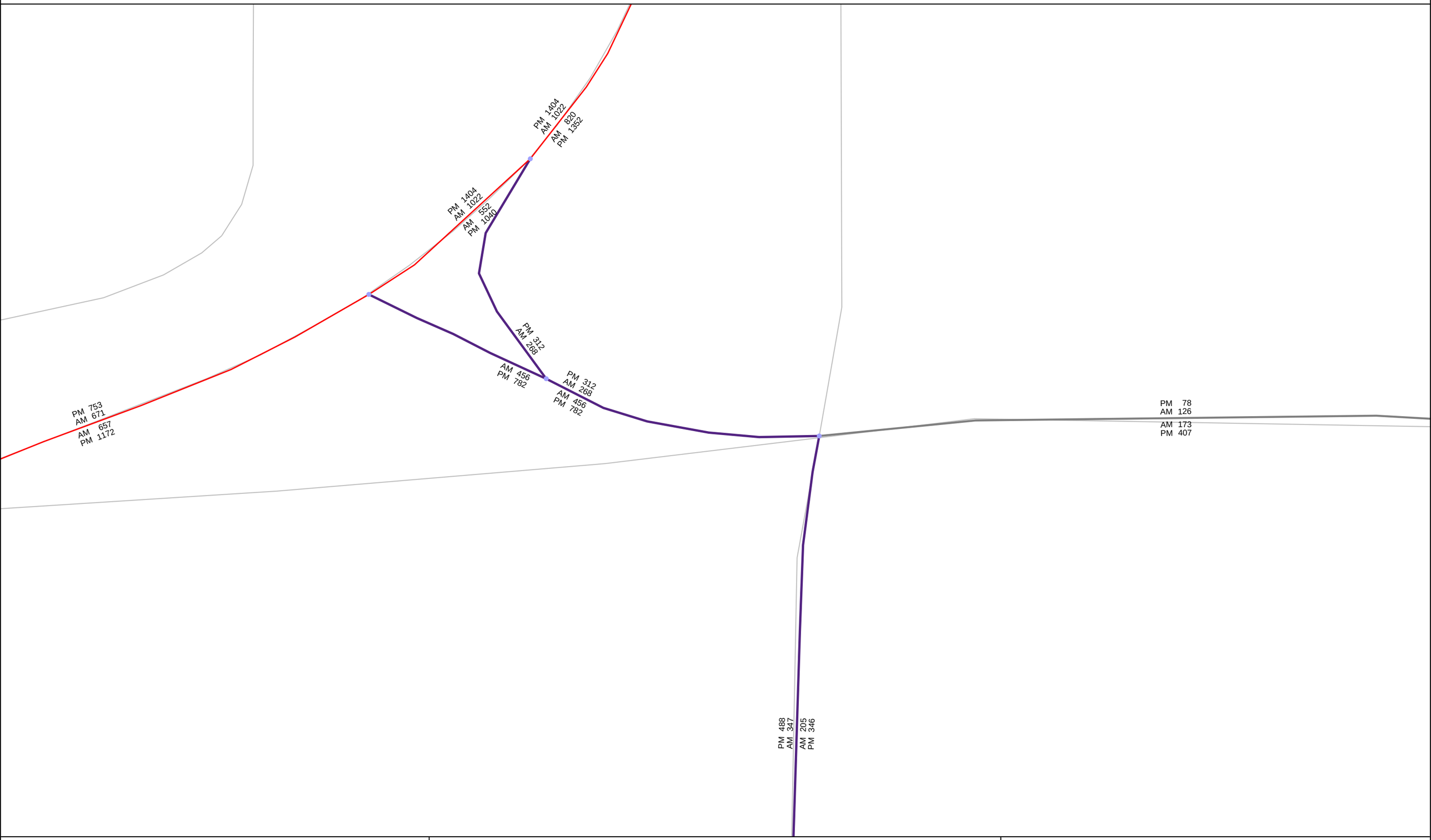

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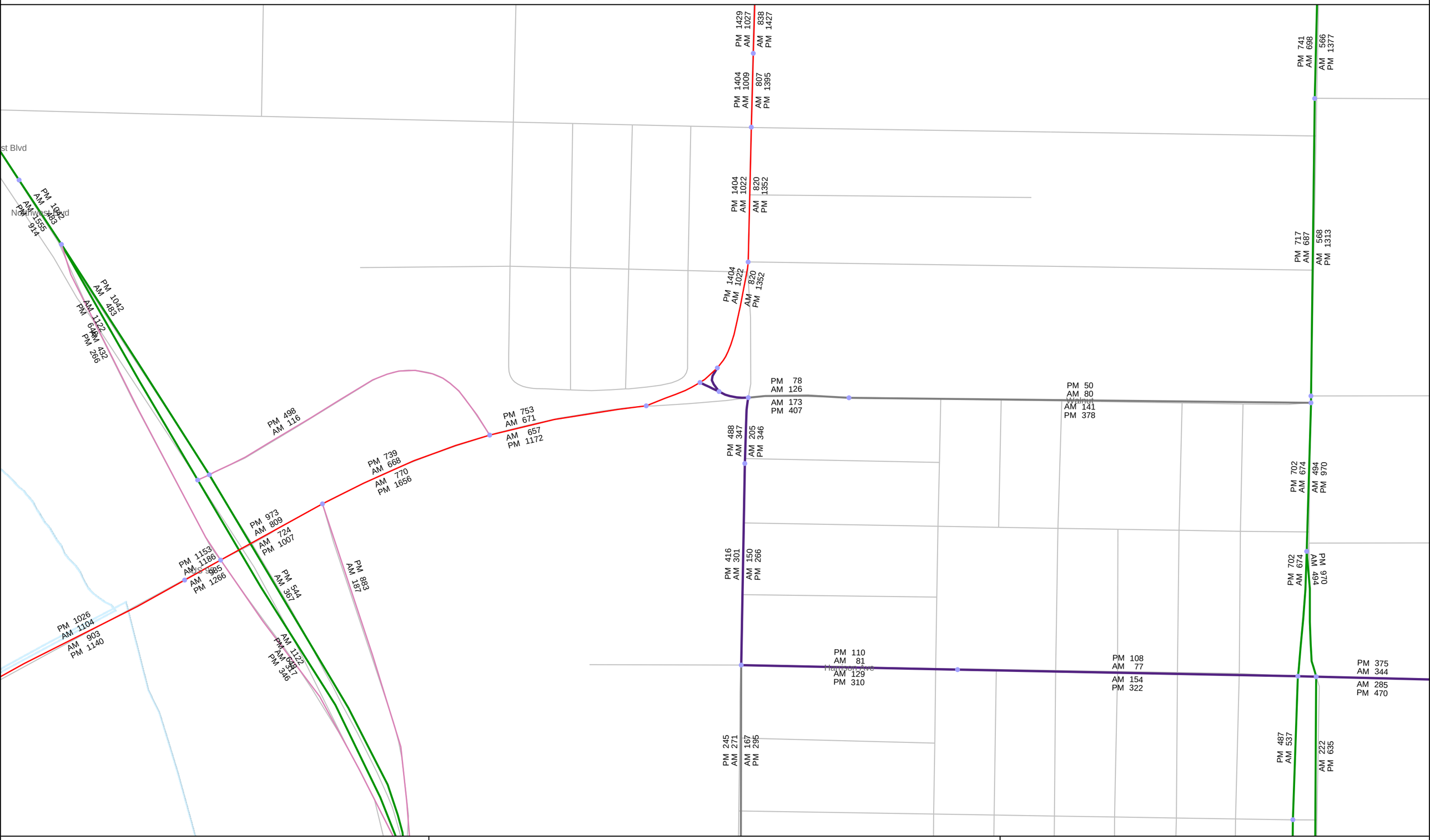
KMPO 2020 BUILD Scenario 1 - At Grade Intersection US 95 - AM & PM PK HR Volumes



US 95 - Lincoln - Harrison	AM & PM PK HR Volumes	KMPO 2020 Build
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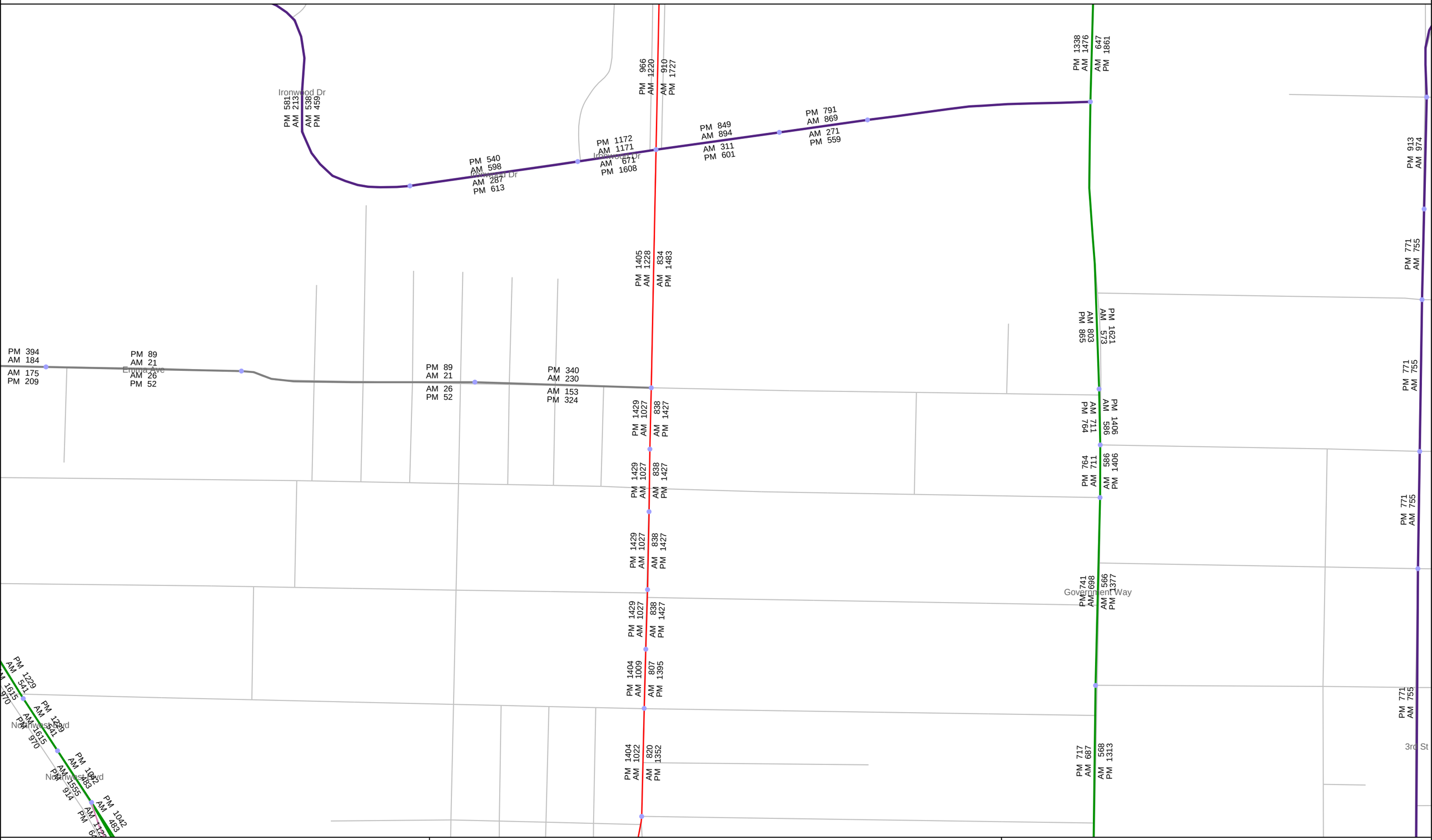
KMPO 2020 BUILD Scenario 1 - At Grade Intersection US 95 - AM & PM PK HR Volumes



US 95 - Linden to Ironwood	AM & PM PK HR Volumes	KMPO 2020 Build
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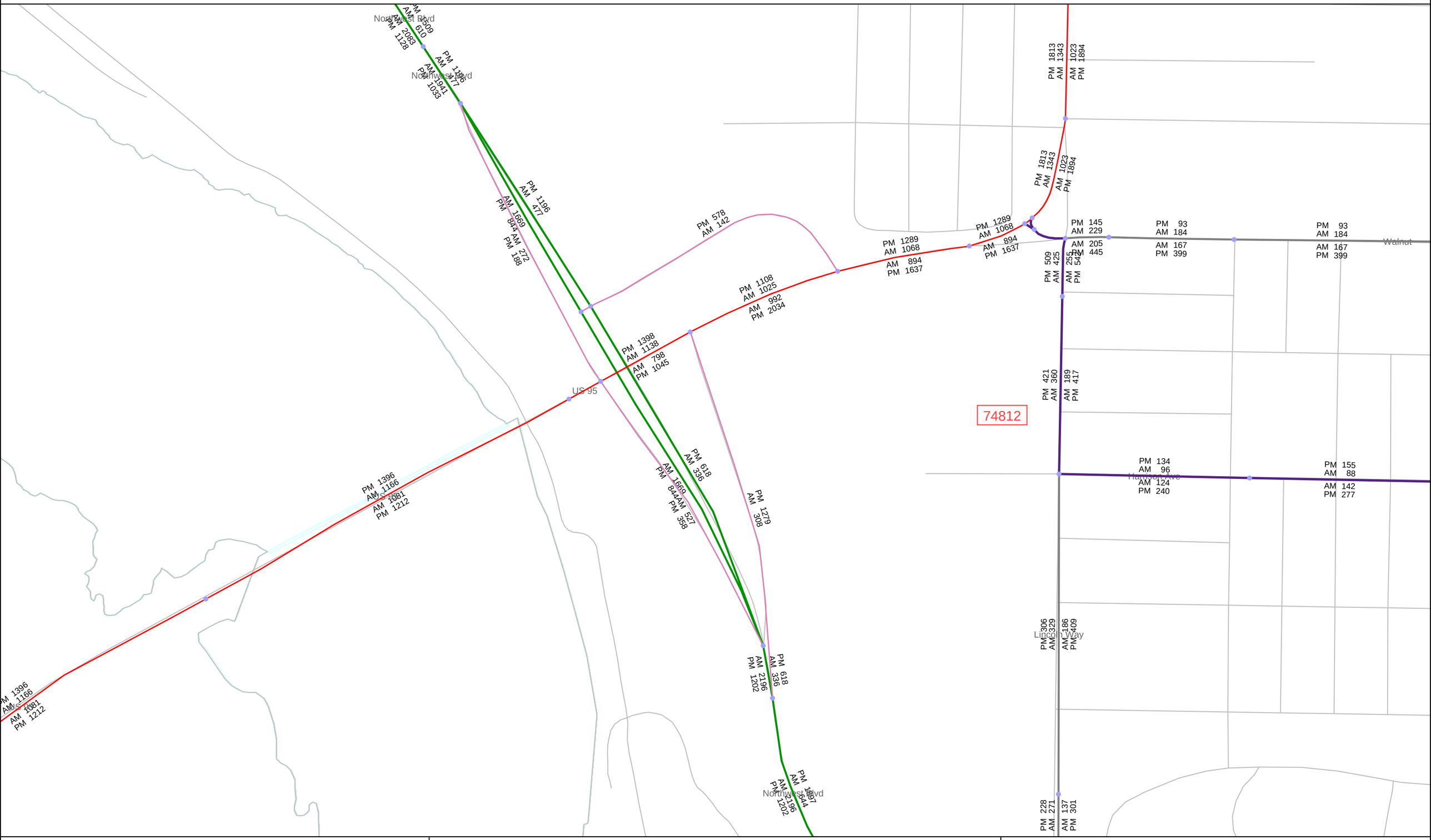
KMPO 2035 BUILD Scenario 1 - At Grade Intersection US 95 - AM & PM PK HR Volumes



Northwest Blvd I/C & US 95	AM & PM PK HR Volumes	KMPO 2035 Build Scenario 1
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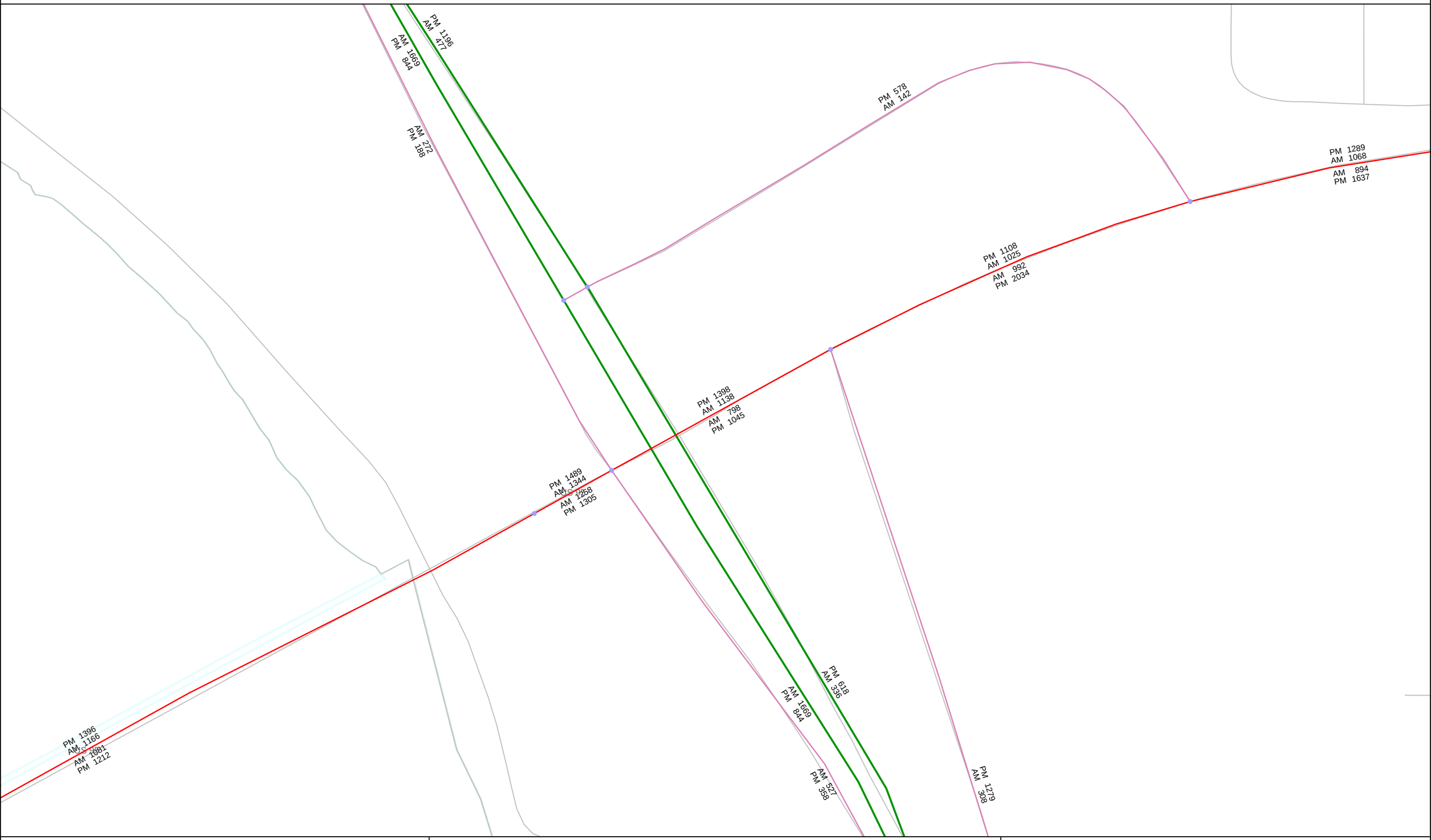

Northwest Blvd I/C & US 95 - Close-up	AM & PM PK HR Volumes	KMPO 2035 Build Scenario 1
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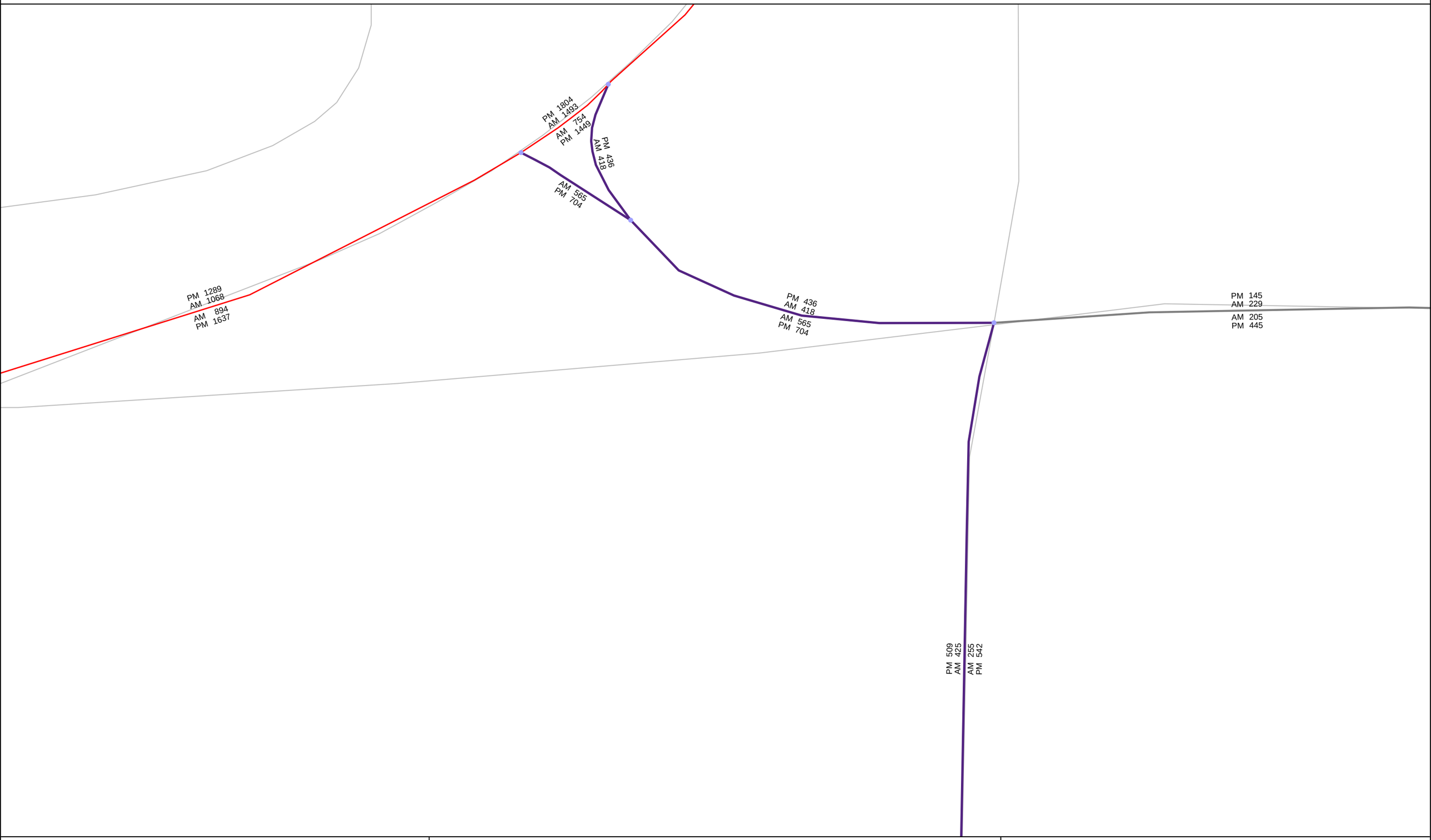
KMPO 2035 BUILD Scenario 1 - At Grade Intersection US 95 - AM & PM PK HR Volumes



US 95 & Lincoln	AM & PM PK HR Volumes	KMPO 2035 Build Scenario 1
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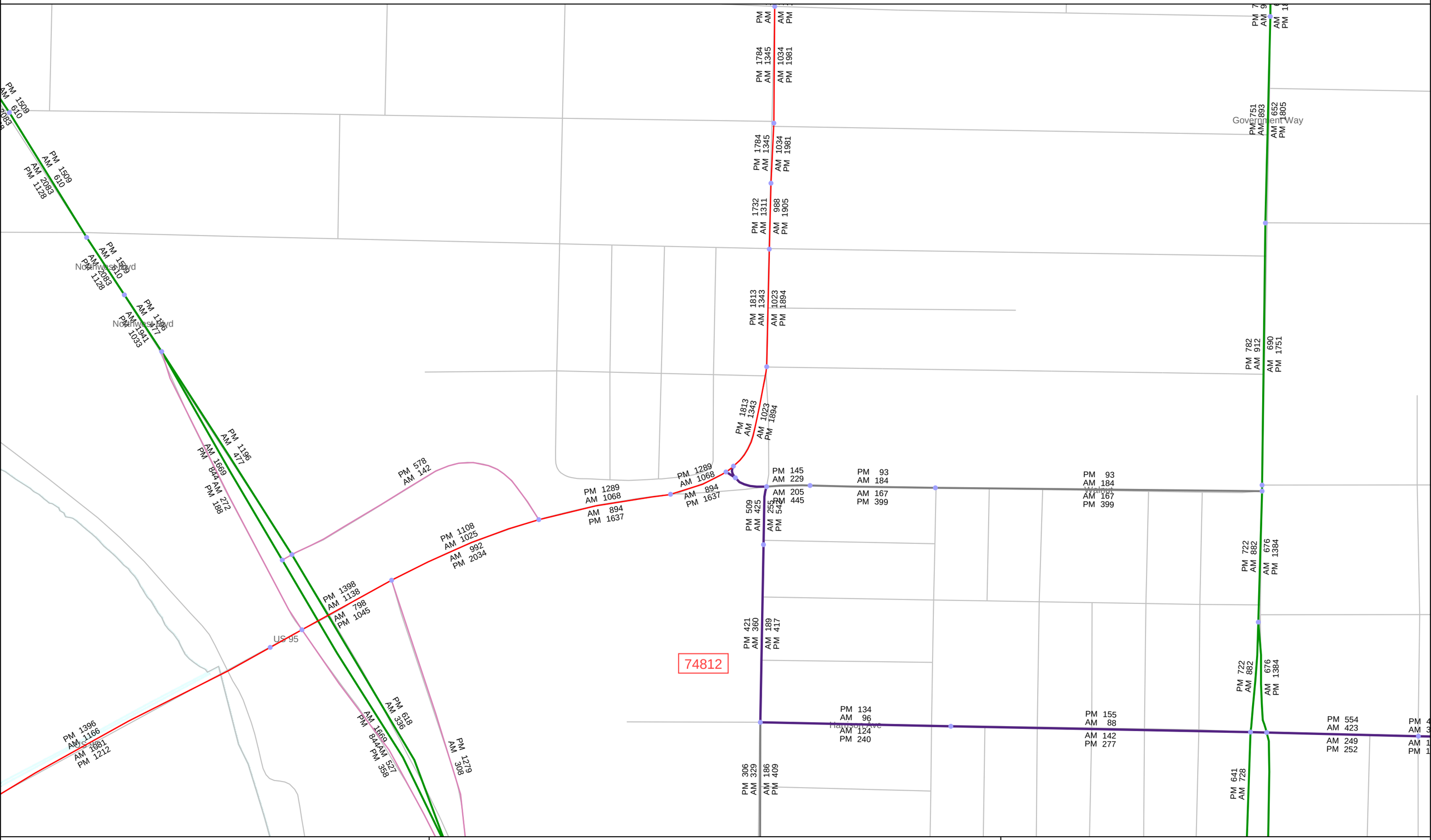
KMPO 2035 BUILD Scenario 1 - At Grade Intersection US 95 - AM & PM PK HR Volumes



US 95 - Lincoln - Harrison	AM & PM PK HR Volumes	KMPO 2035 Build Scenario 1
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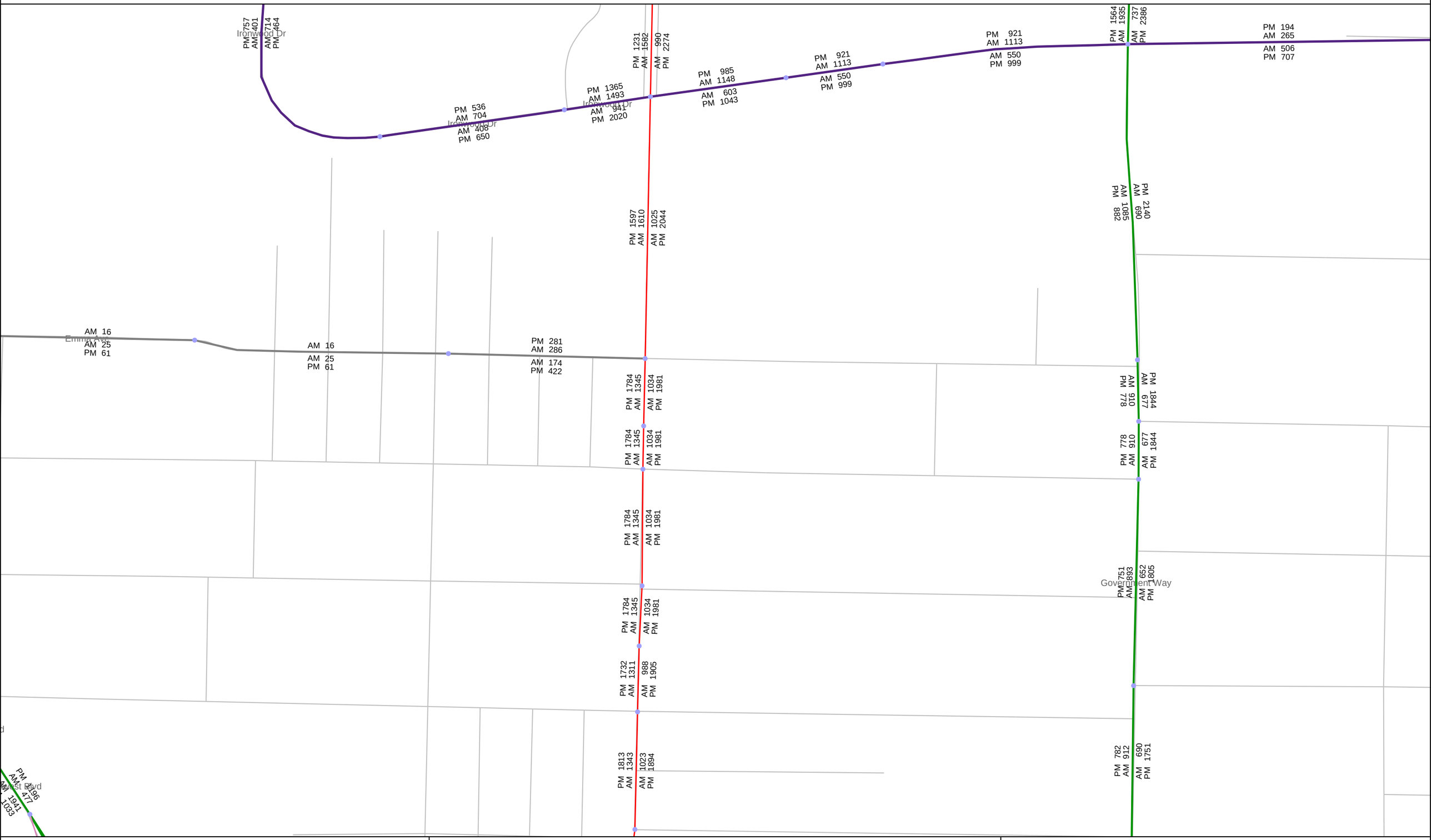
KMPO 2035 BUILD Scenario 1 - At Grade Intersection US 95 - AM & PM PK HR Volumes



US 95 -Linden to Ironwood	AM & PM PK HR Volumes	KMPO 2035 Build Scenario 1
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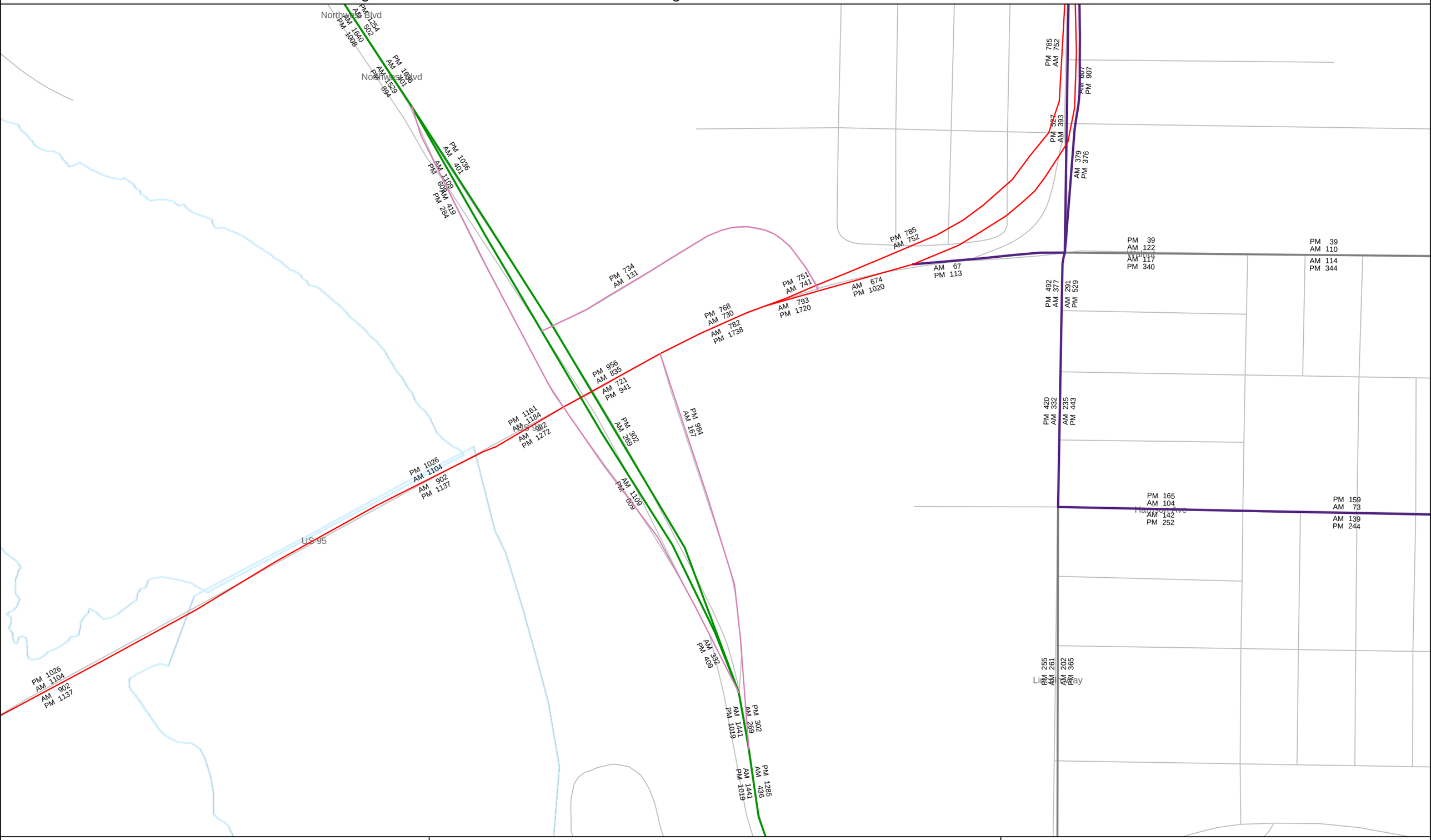
KMPO 2020 BUILD - Scenario 2 - Partial Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95 & NW Blvd I/C	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
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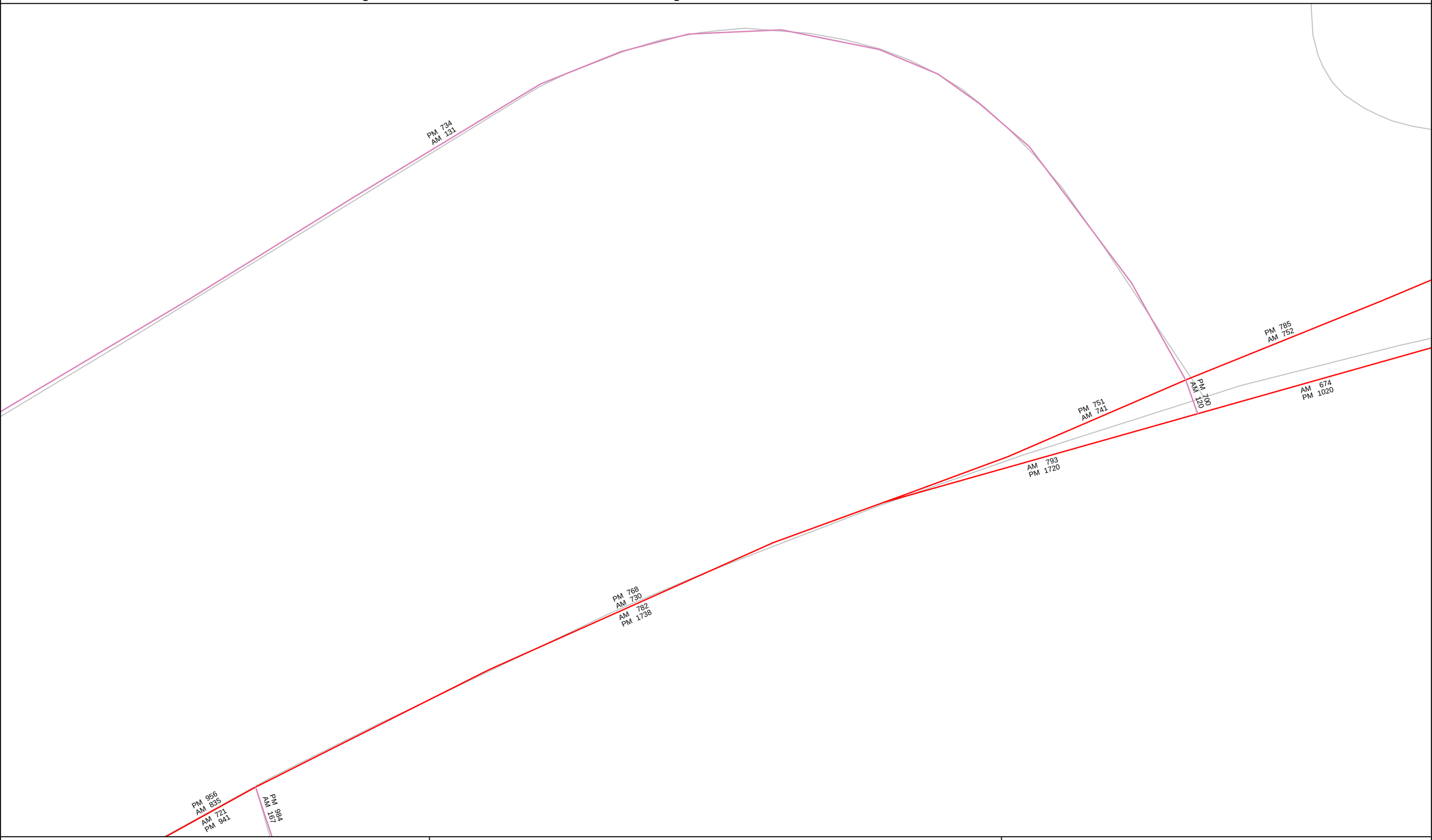
KMPO 2020 BUILD - Scenario 2 - Partial Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95 & NW Blvd NW Ramp	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
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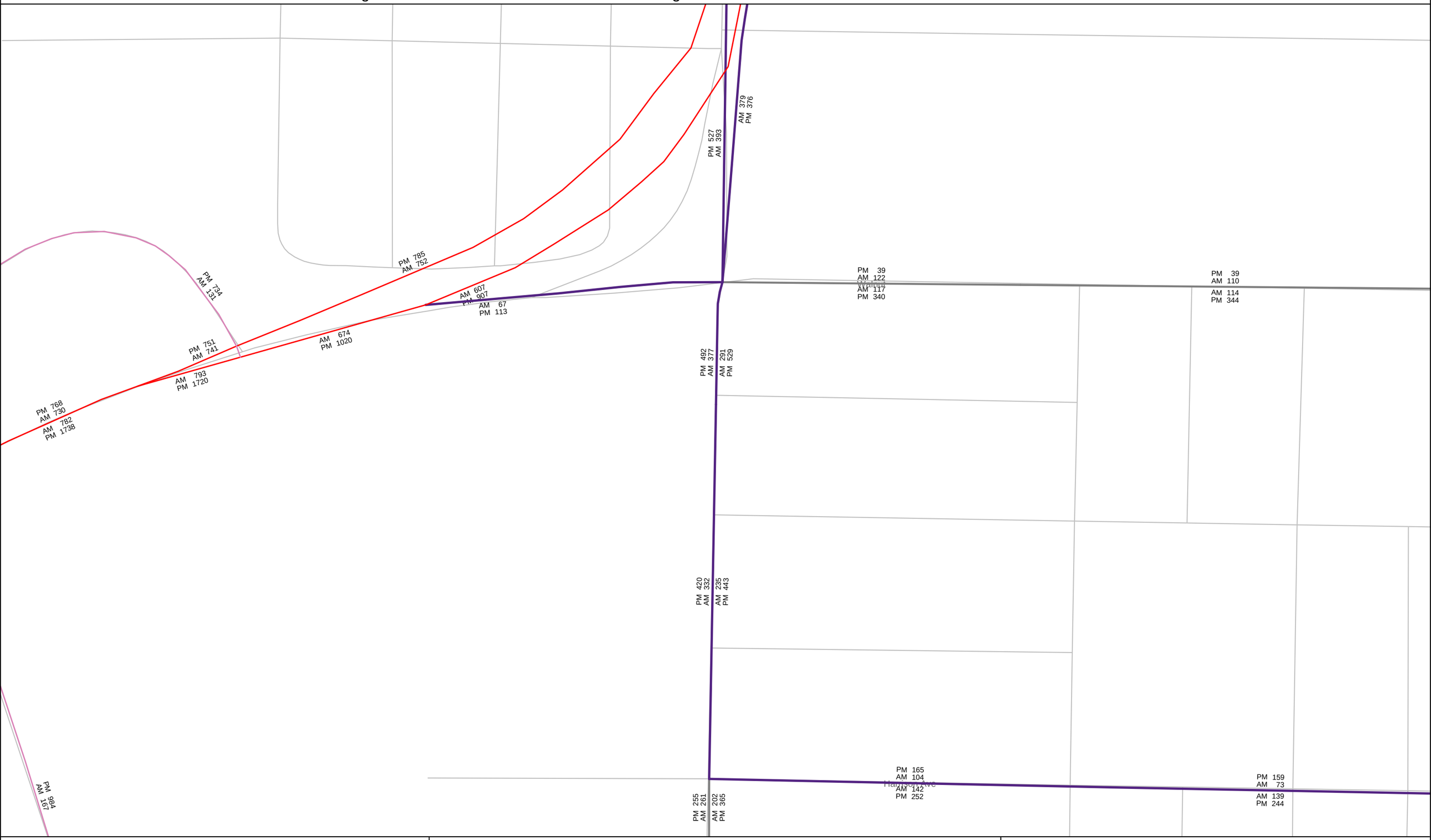
KMPO 2020 BUILD - Scenario 2 - Partial Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95 & Lincoln Way	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
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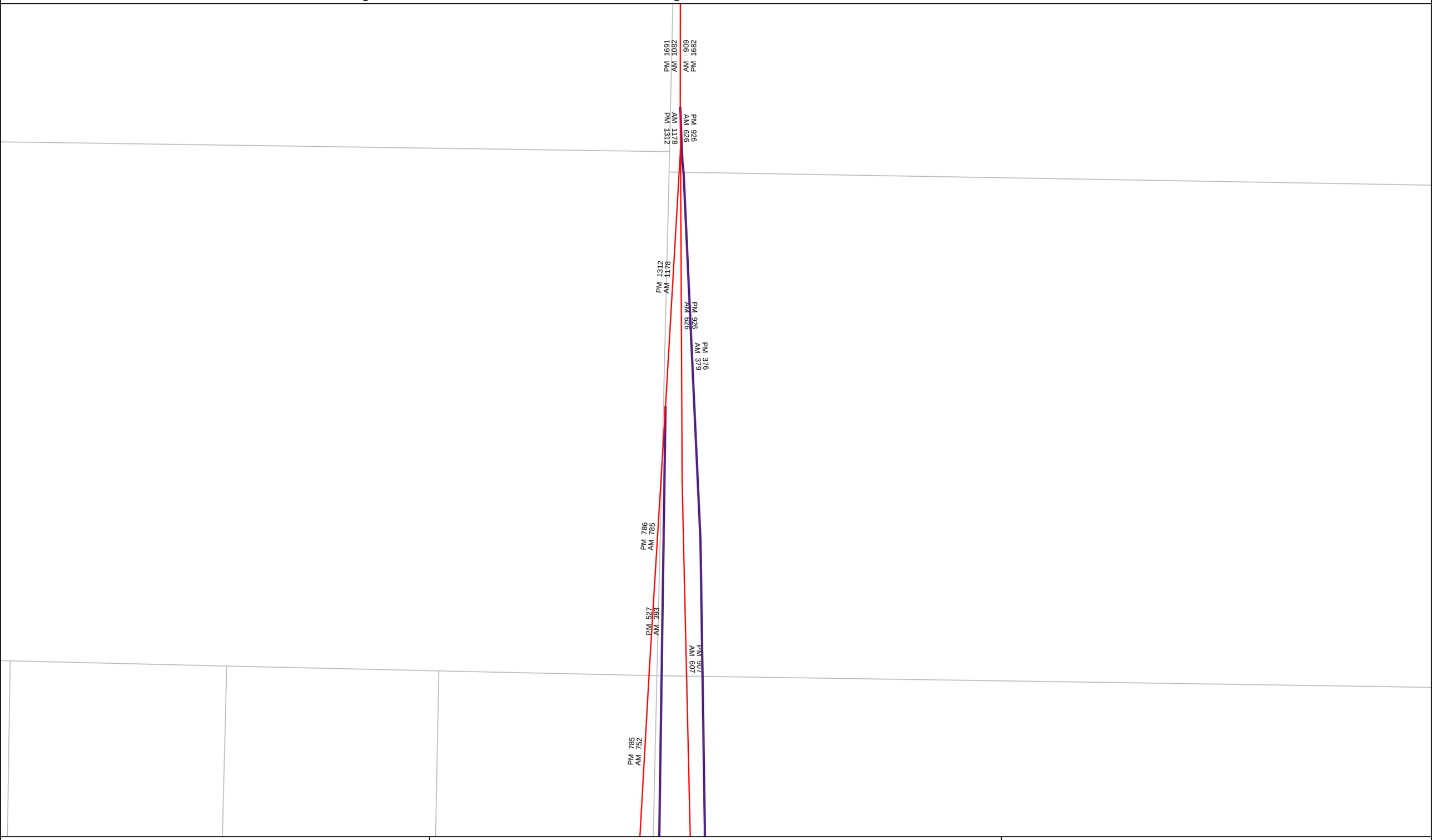
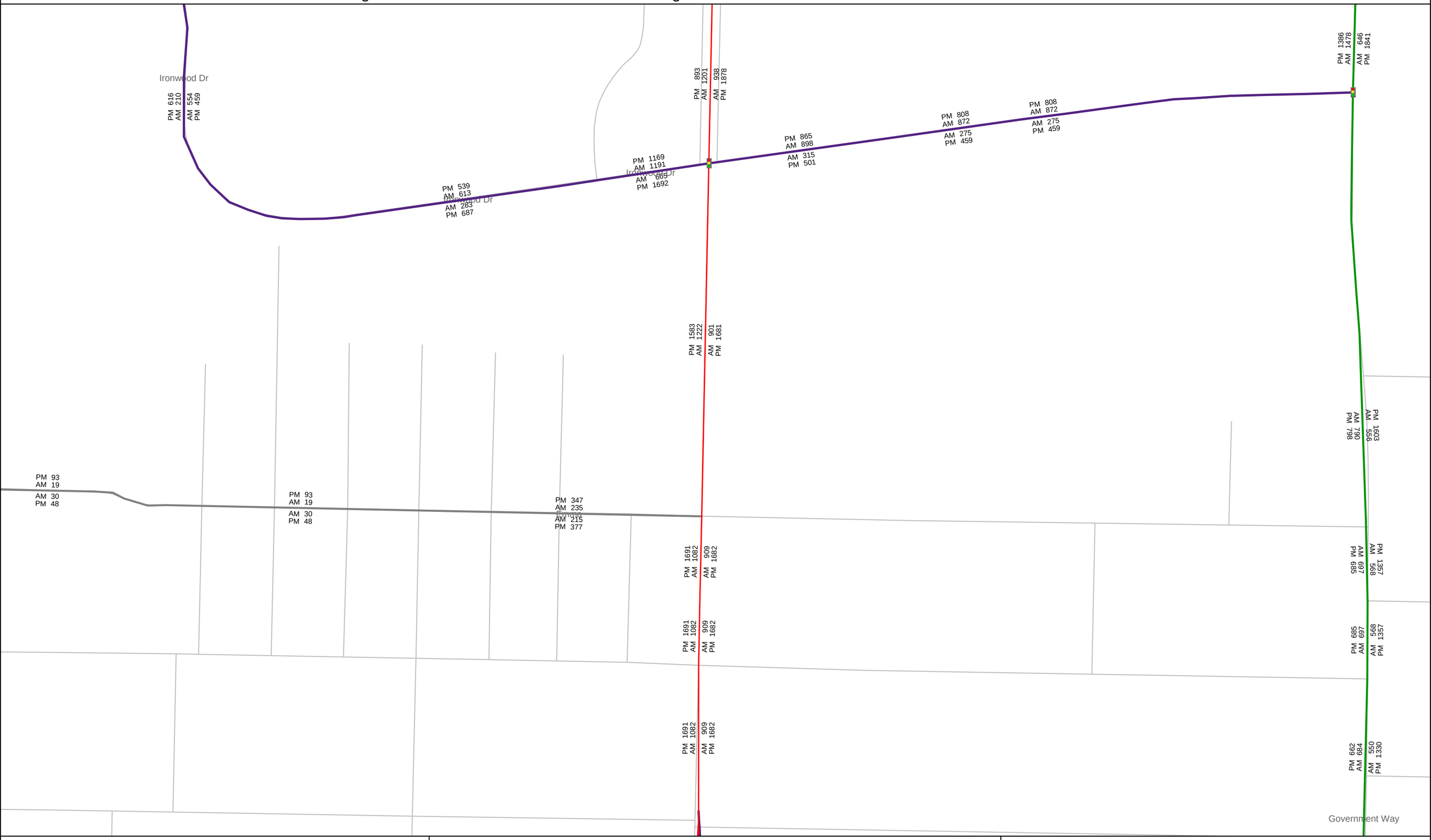
KMPO 2020 BUILD - Scenario 2 - Partial Interchange - US 95 - AM & PM PK HR Volumes & Signals



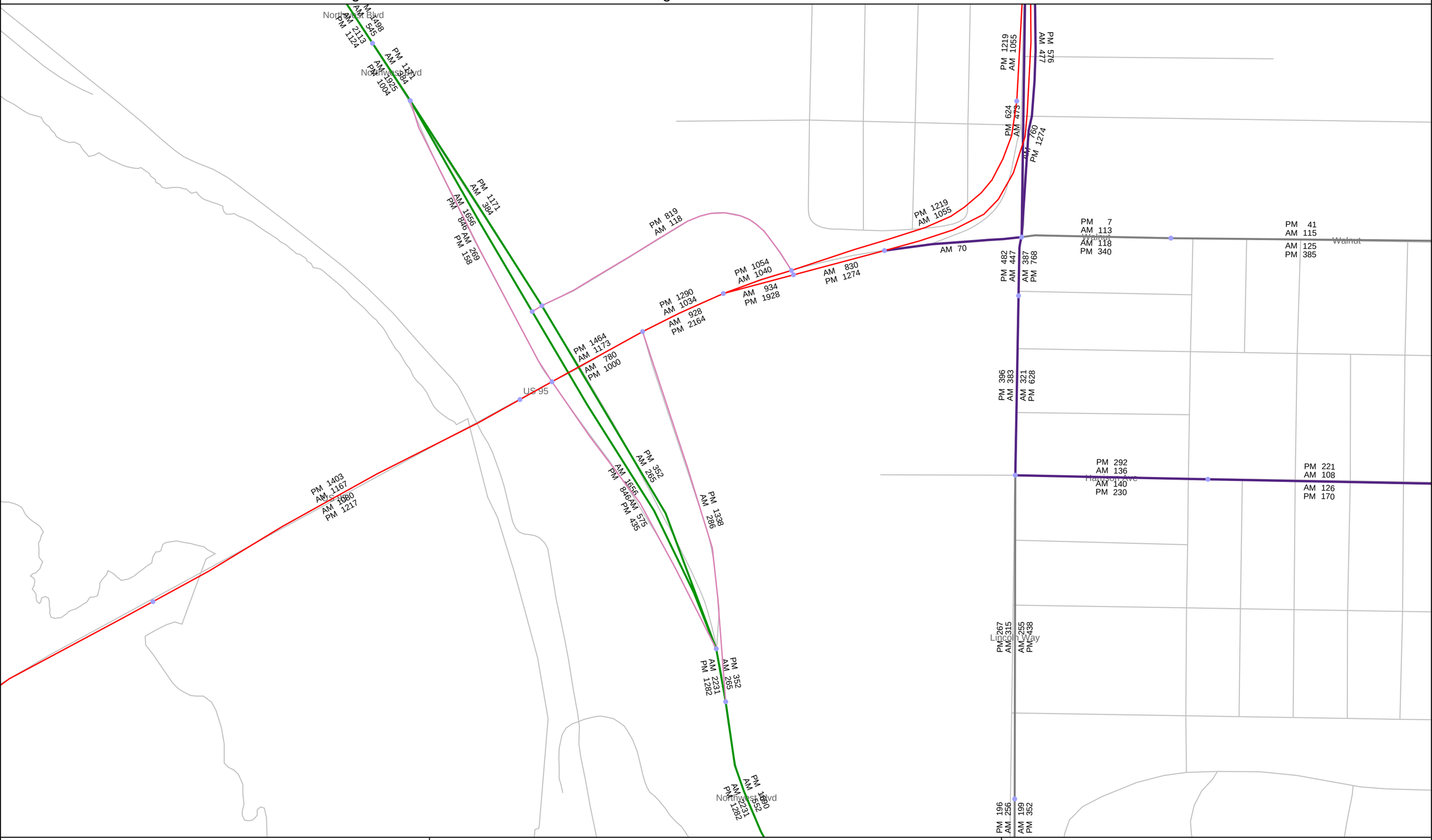
US 95, Lacrosse & Mill St	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 11.07.2013	KMPO_2020_BUILD_US95_Scenario2_Partial Interchange_7-11-13.ver	1:684

KMPO 2020 BUILD - Scenario 2 - Partial Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95, Emma to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 11.07.2013	KMPO_2020_BUILD_US95_Scenario2_Partial Interchange_7-11-13.ver	1:2086

KMPO 2035 BUILD Scenario 2 - Partial Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95 & NW Blvd I/C	AM & PM PK HR Volumes	KMPO 2035 Build Model
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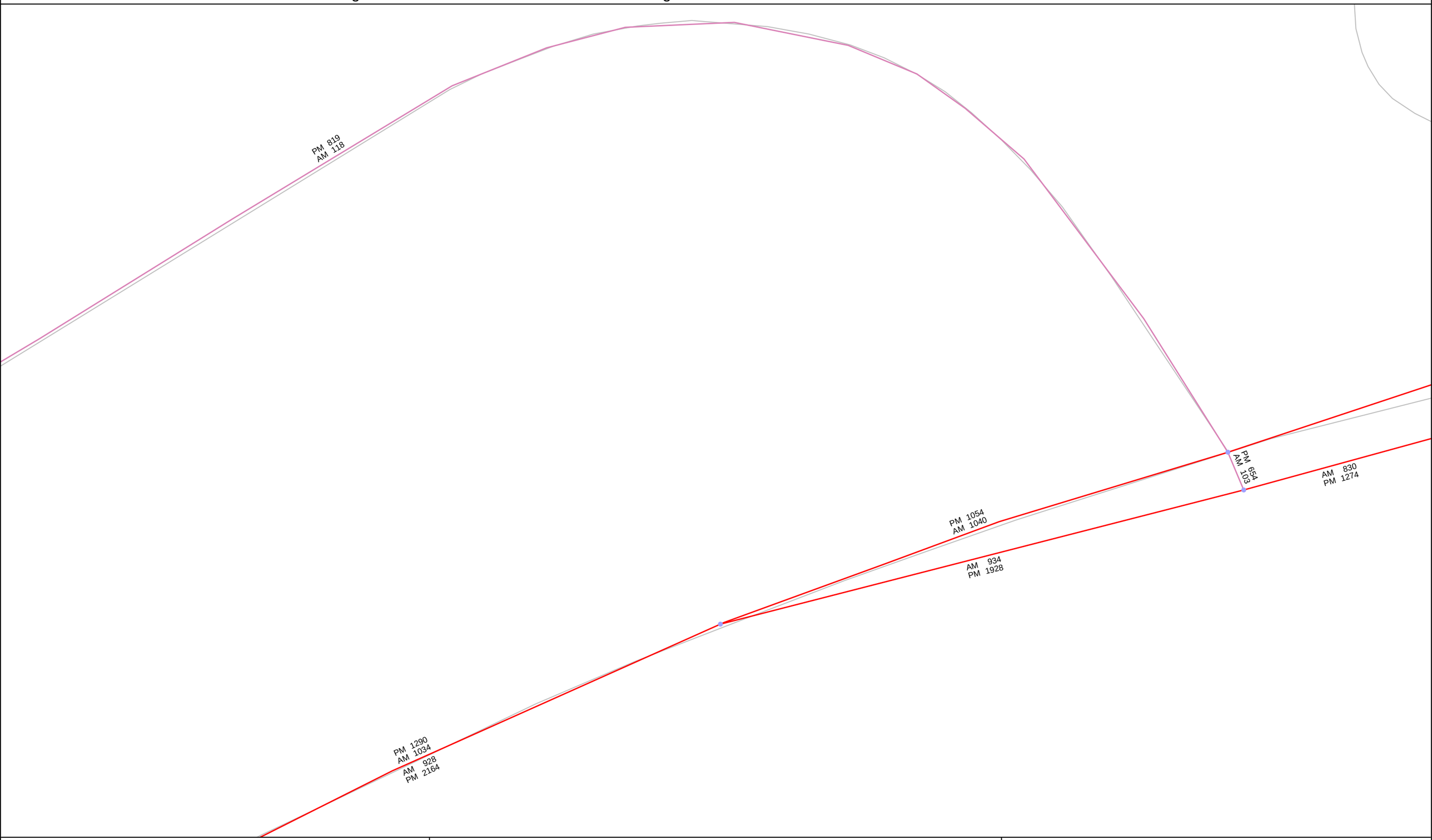
KMPO 2035 BUILD Scenario 2 - Partial Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95 & NW Blvd NW Ramp	AM & PM PK HR Volumes	KMPO 2035 Build Model
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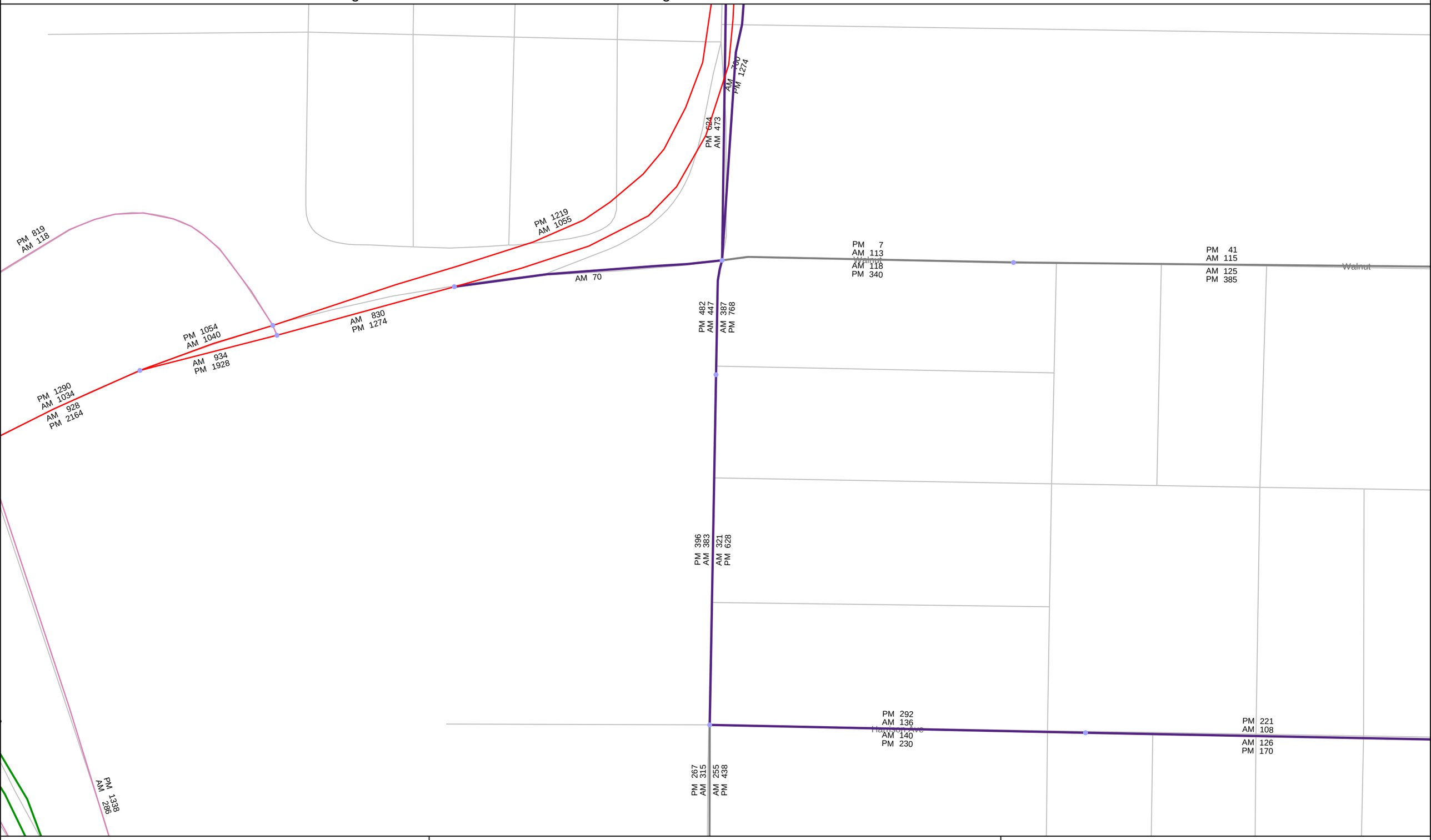
KMPO 2035 BUILD Scenario 2 - Partial Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95 & Lincoln Way	AM & PM PK HR Volumes	KMPO 2035 Build Model
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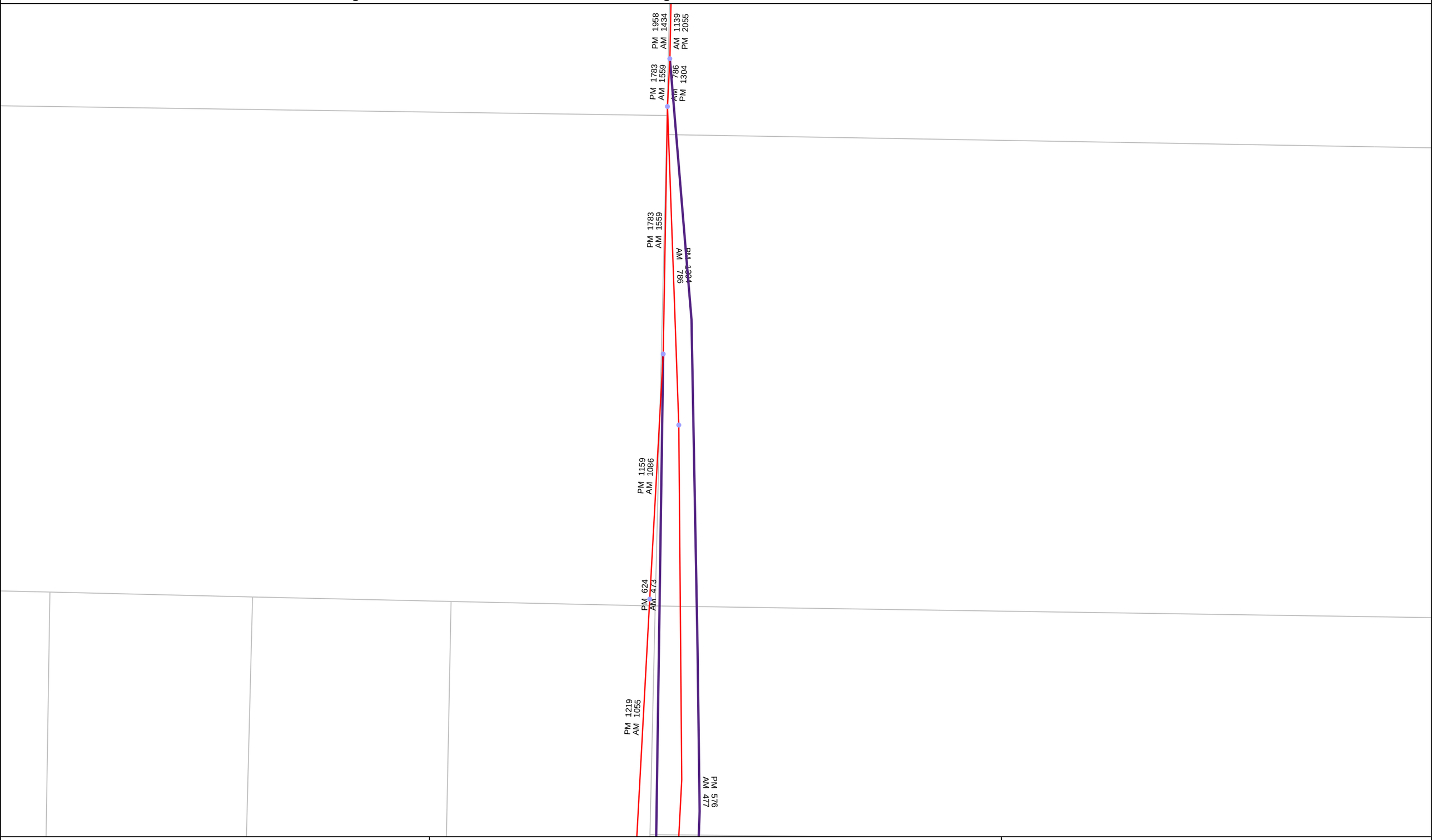
KMPO 2035 BUILD Scenario 2 - Partial Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95 & Lacrosse, Mill St	AM & PM PK HR Volumes	KMPO 2035 Build Model
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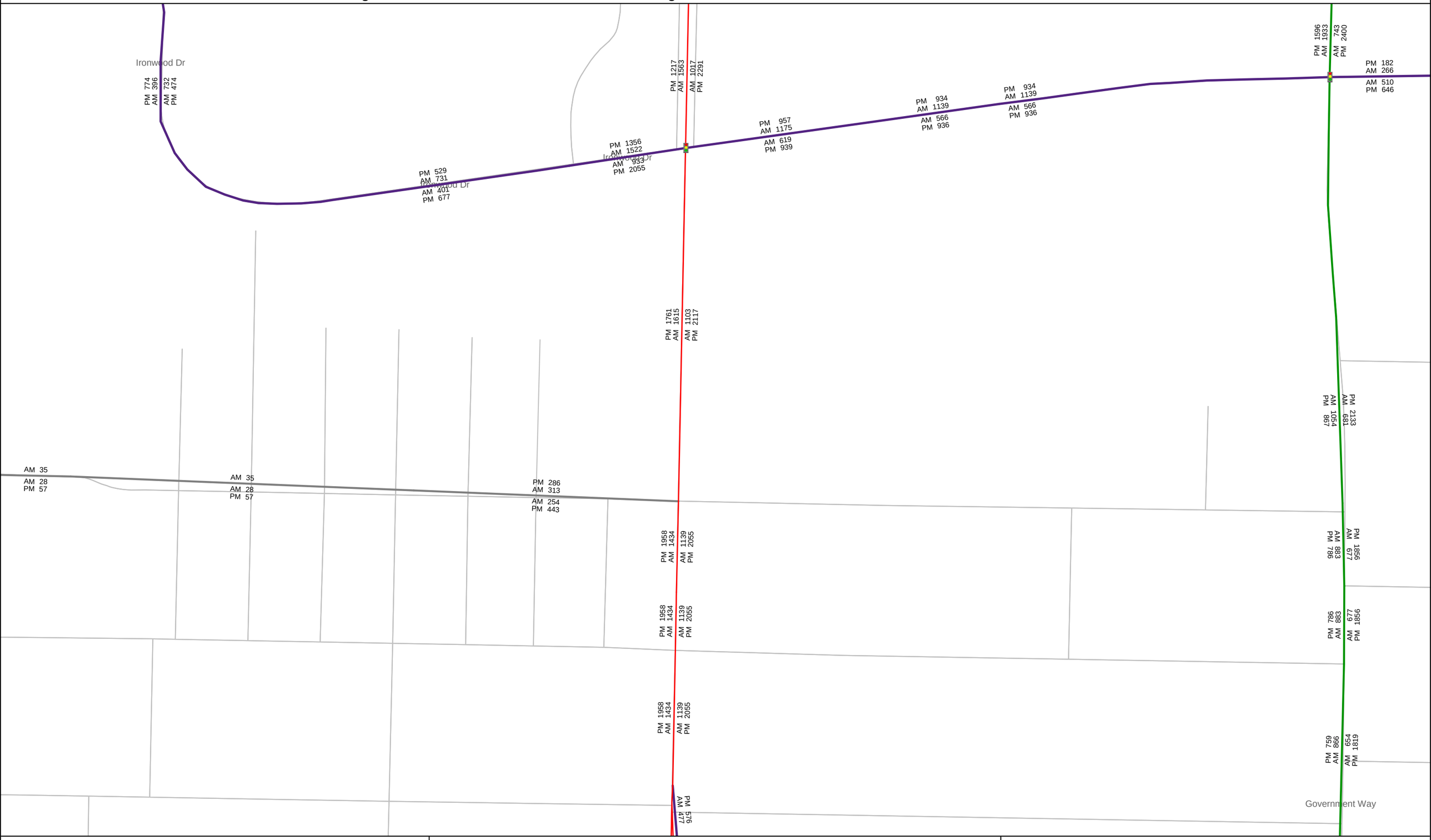
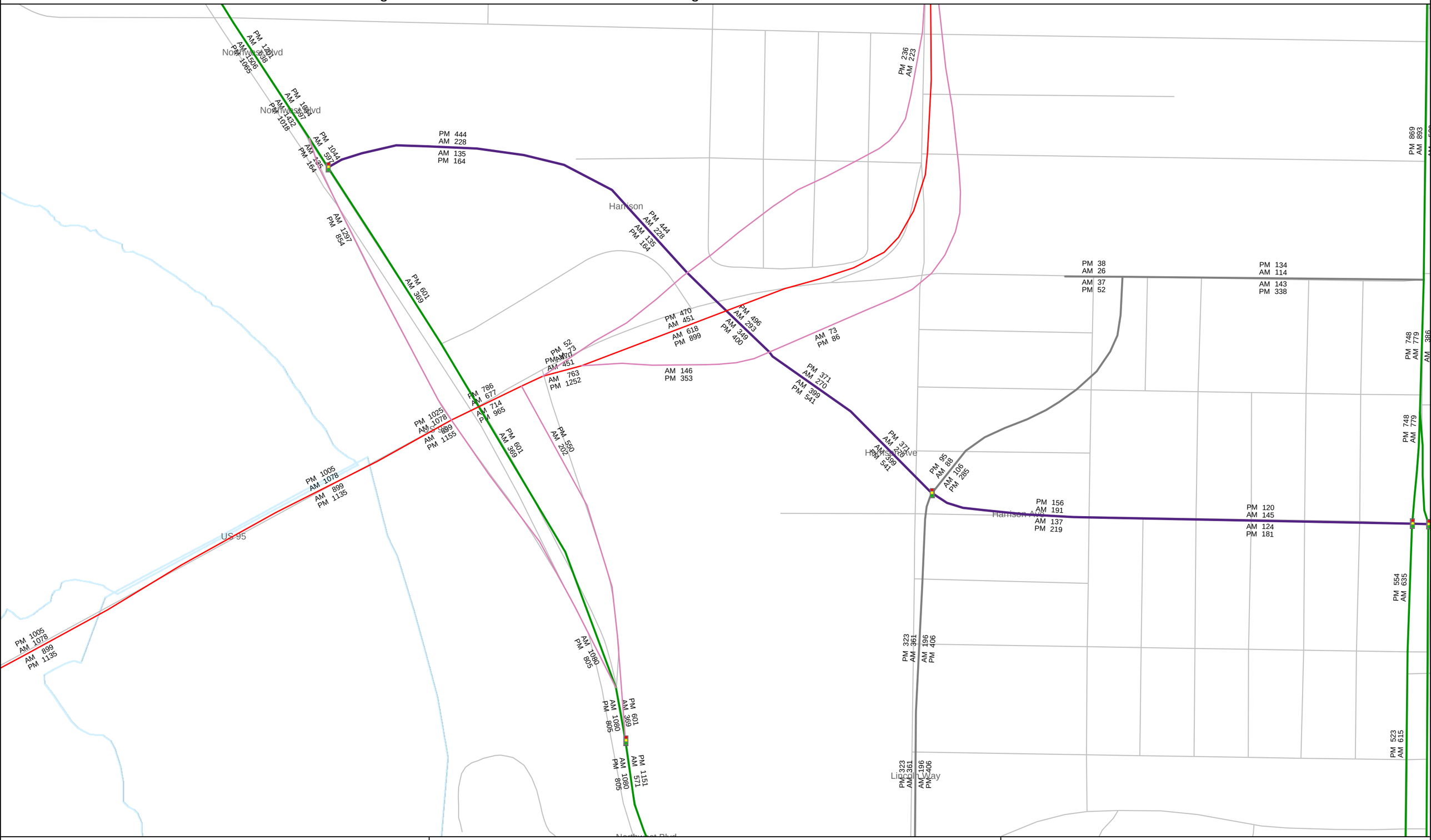
KMPO 2035 BUILD - Scenario 2 - Partial Interchange -US 95 - AM & PM PK HR Volumes & Signals



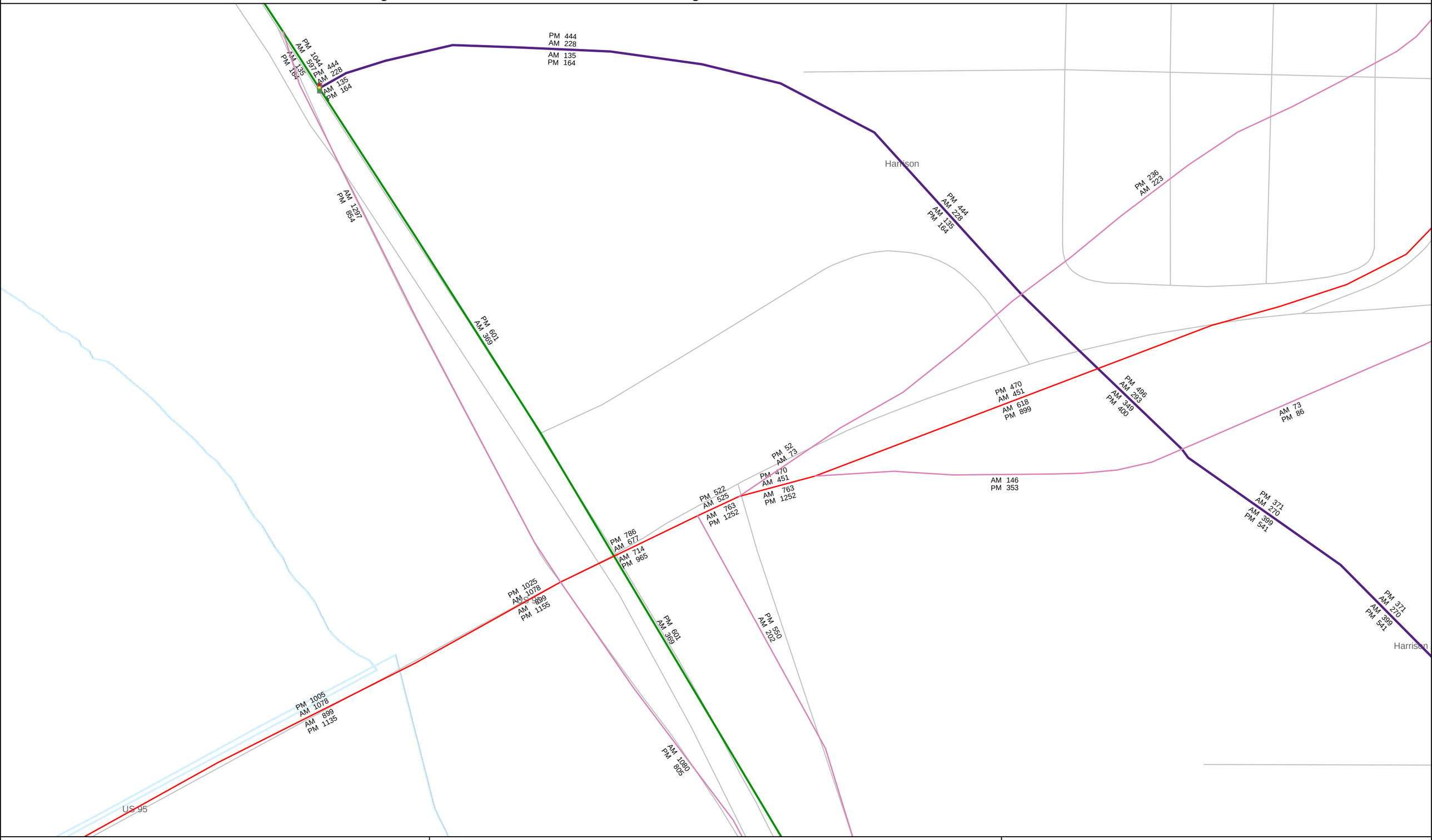
US 95, Emma to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2035 Build Model
Created on: 11.07.2013	KMPO_2035_BUILD_US95_Scenario2_Partial_IC_7-11-13.ver	1:2086

KMPO 2020 BUILD - Scenario 3 - Diamond Interchange - US 95 - AM & PM PK HR Volumes & Signals



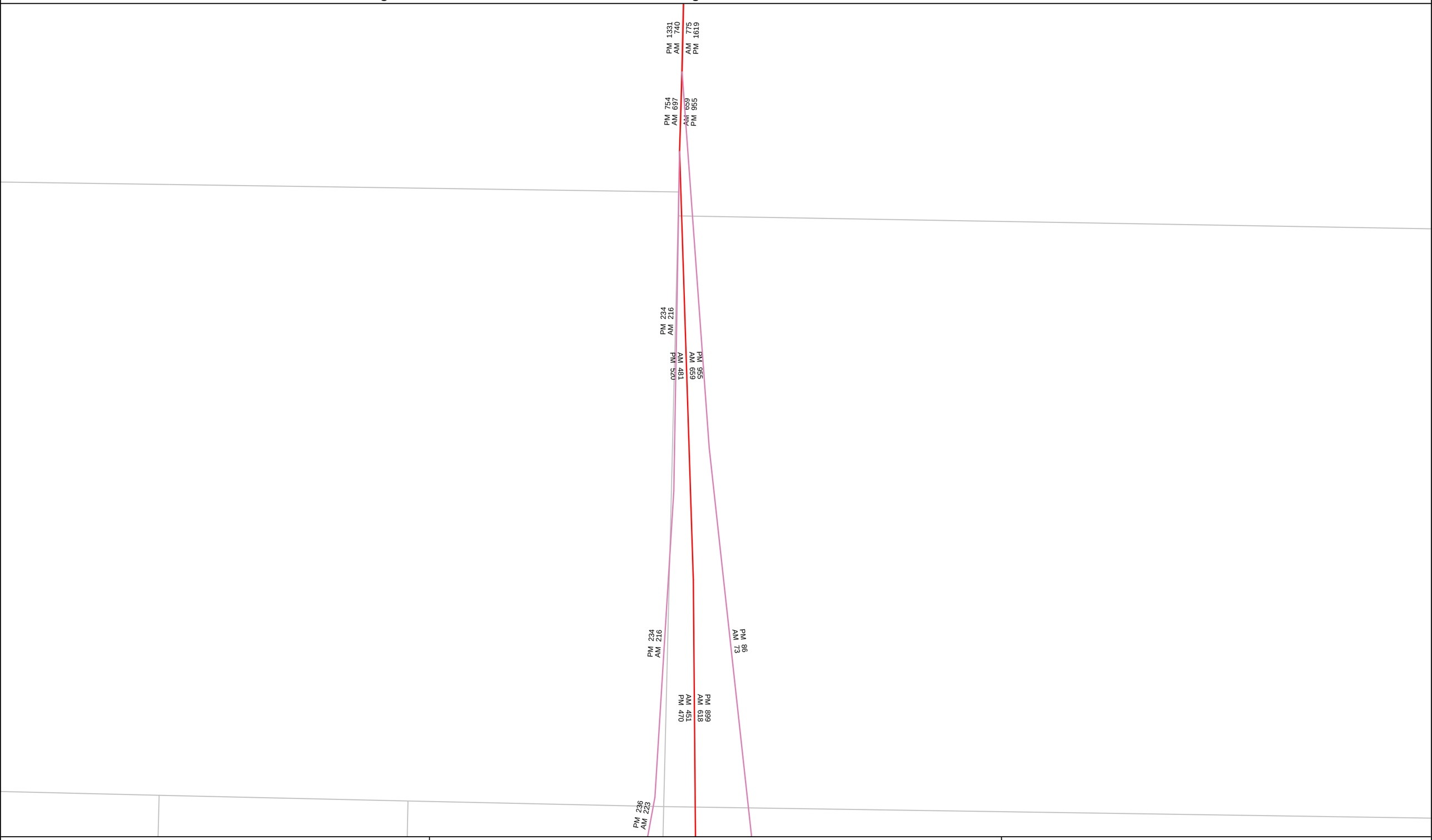
US 95 & NW Blvd	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 11.07.2013	KMPO_2020_BUILD_US95_Scenario3_DiamondIC_7-11-13.ver	1:2779

KMPO 2020 BUILD - Scenario 3 - Diamond Interchange - US 95 - AM & PM PK HR Volumes & Signals



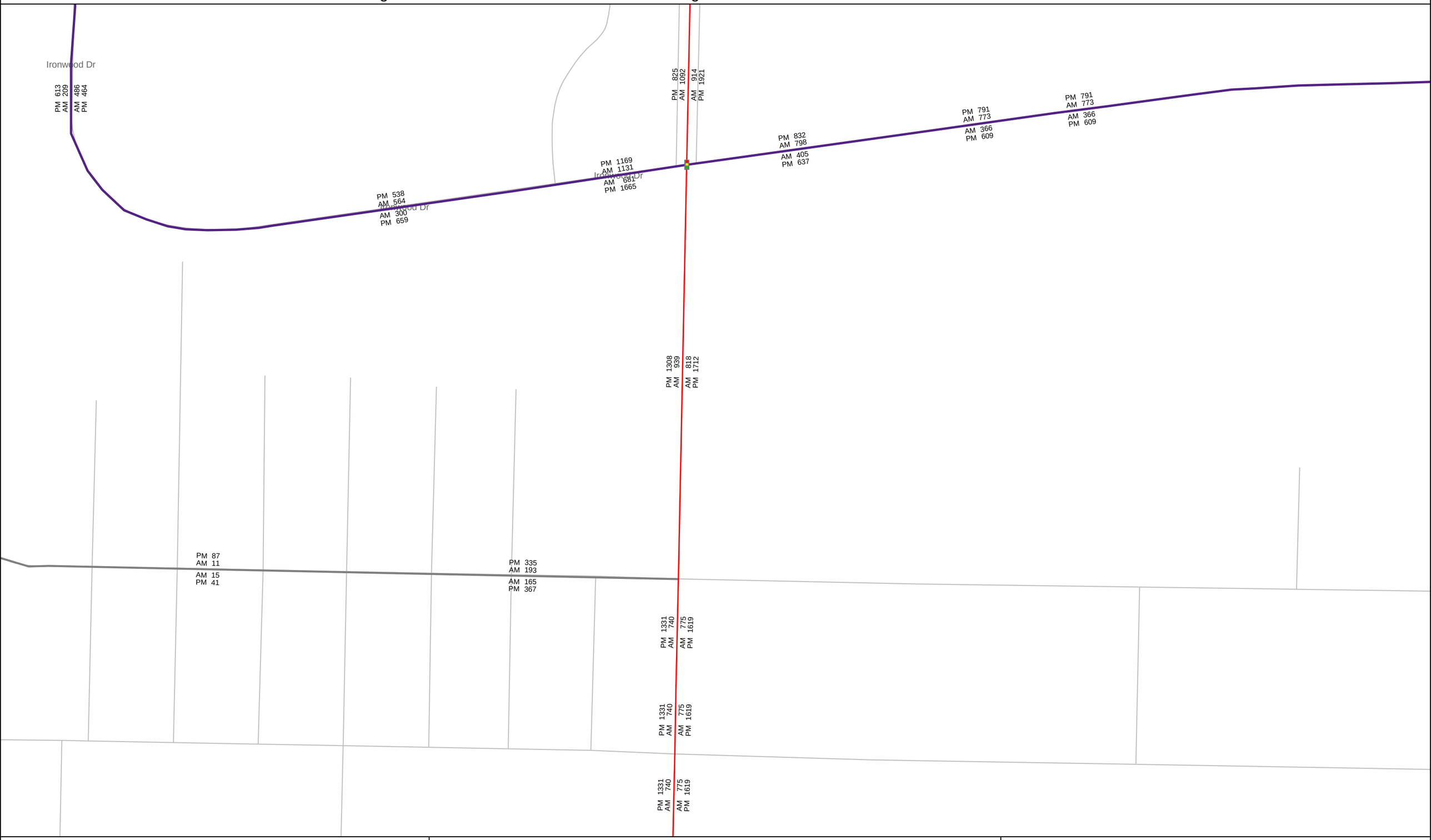
US 95 & NW Blvd - Close-up	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 11.07.2013	KMPO_2020_BUILD_US95_Scenario3_DiamondIC_7-11-13.ver	1:1423

KMPO 2020 BUILD - Scenario 3 - Diamond Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95 - Lacrosse & Mill St	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 11.07.2013	KMPO_2020_BUILD_US95_Scenario3_DiamondIC_7-11-13.ver	1:583

KMPO 2020 BUILD - Scenario 3 - Diamond Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95 -Emma to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
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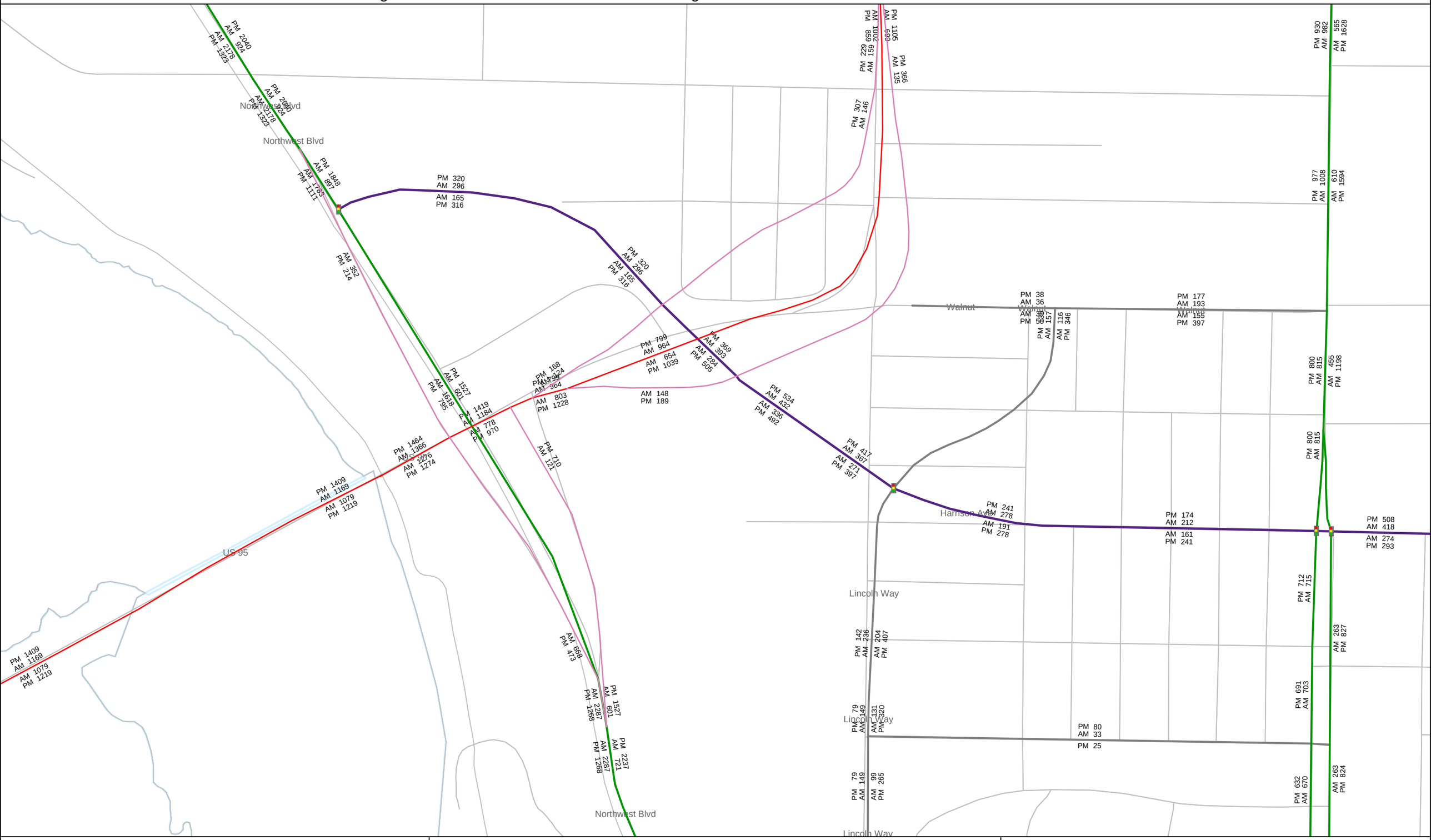
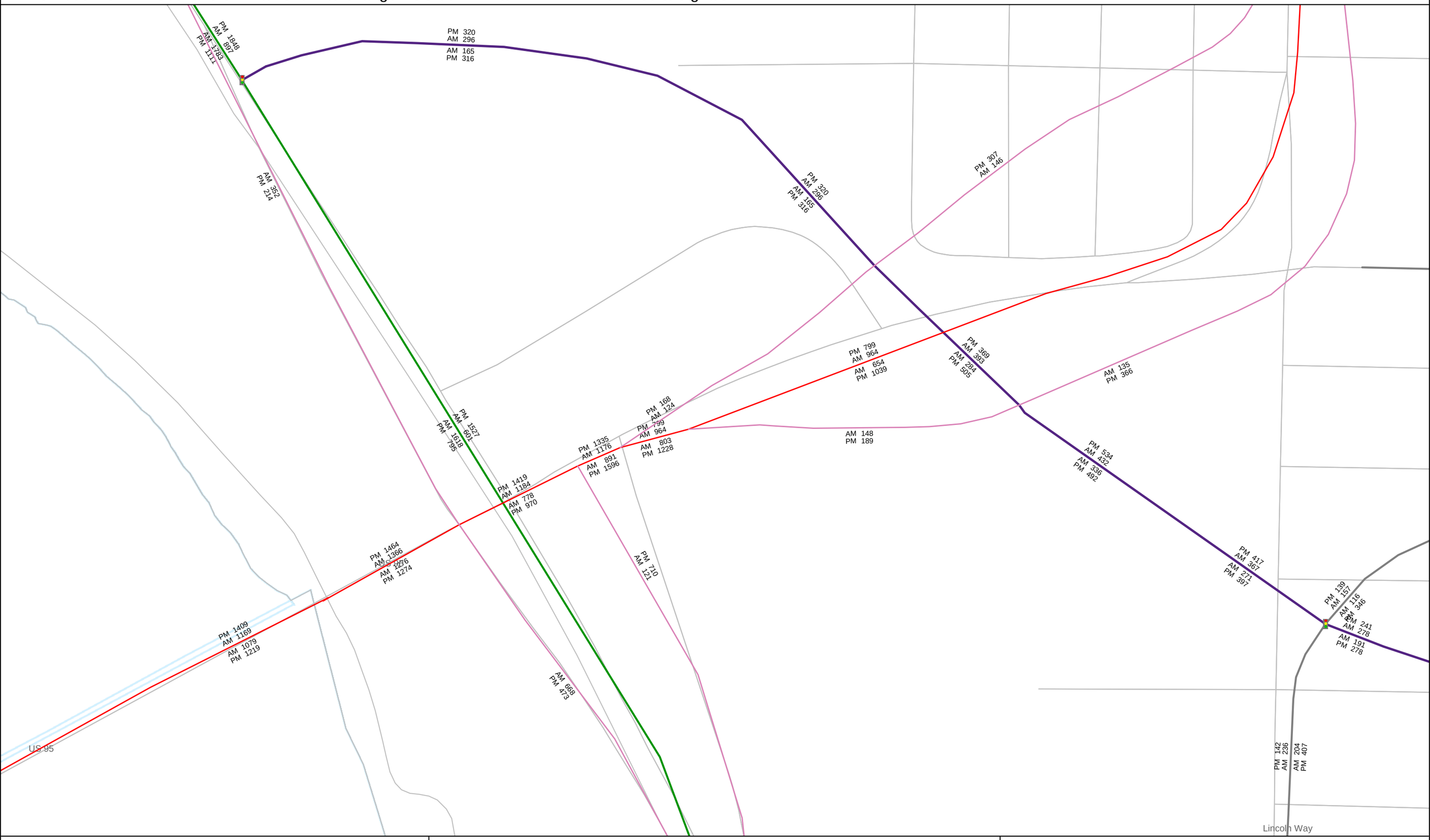
KMPO 2035 BUILD - Scenario 3 - Diamond Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95 & NW Blvd	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD MODEL
Created on: 11.07.2013	KMPO_2035_BUILD_US95_Scenario3_DiamondIC_IC_7-11-13.ver	1:3081

KMPO 2035 BUILD - Scenario 3 - Diamond Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95 & NW Blvd Close-up	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD MODEL
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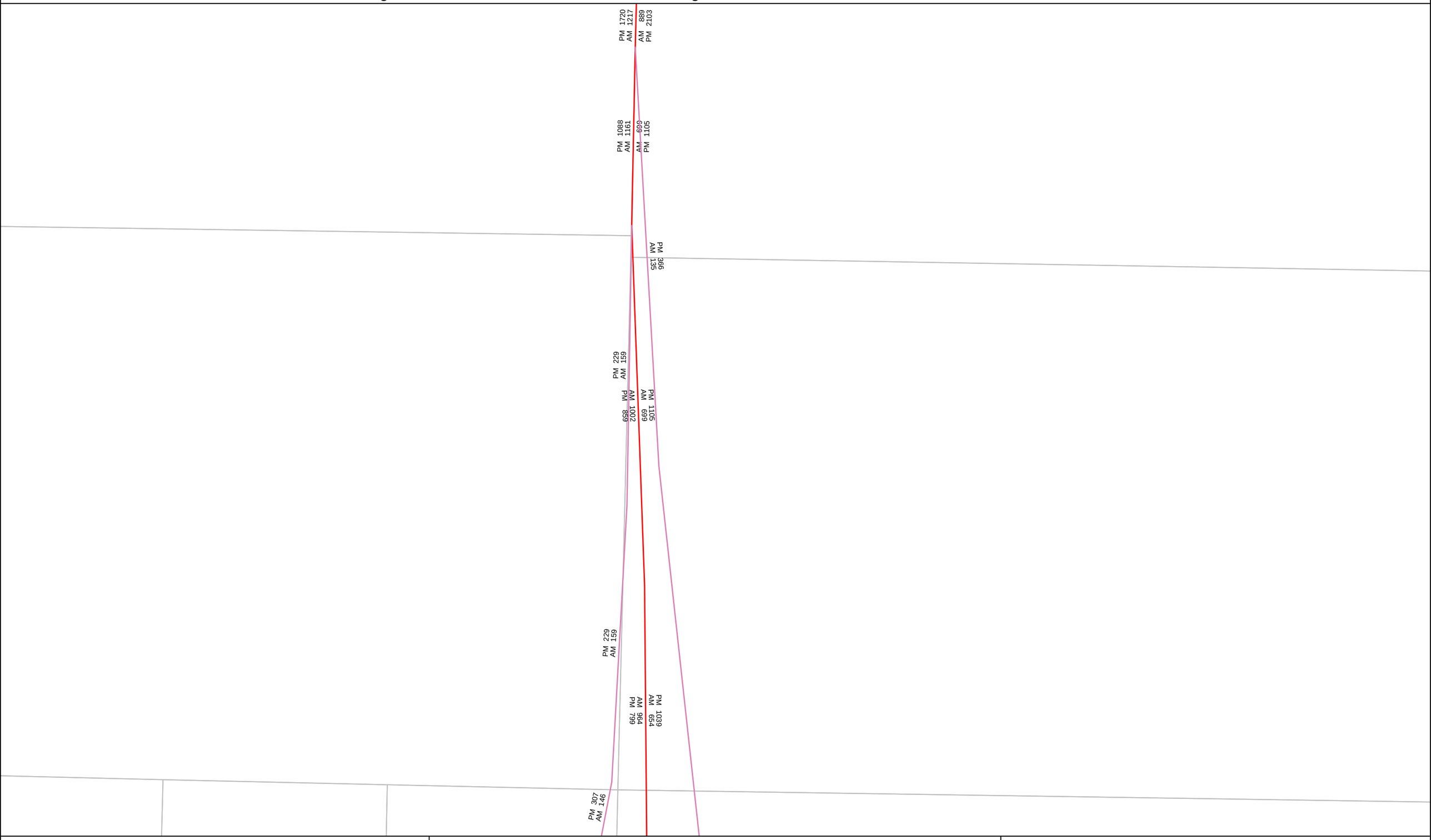
KMPO 2035 BUILD - Scenario 3 - Diamond Interchange - US 95 - AM & PM PK HR Volumes & Signals



US 95, Lacrosse & Mill St	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD MODEL
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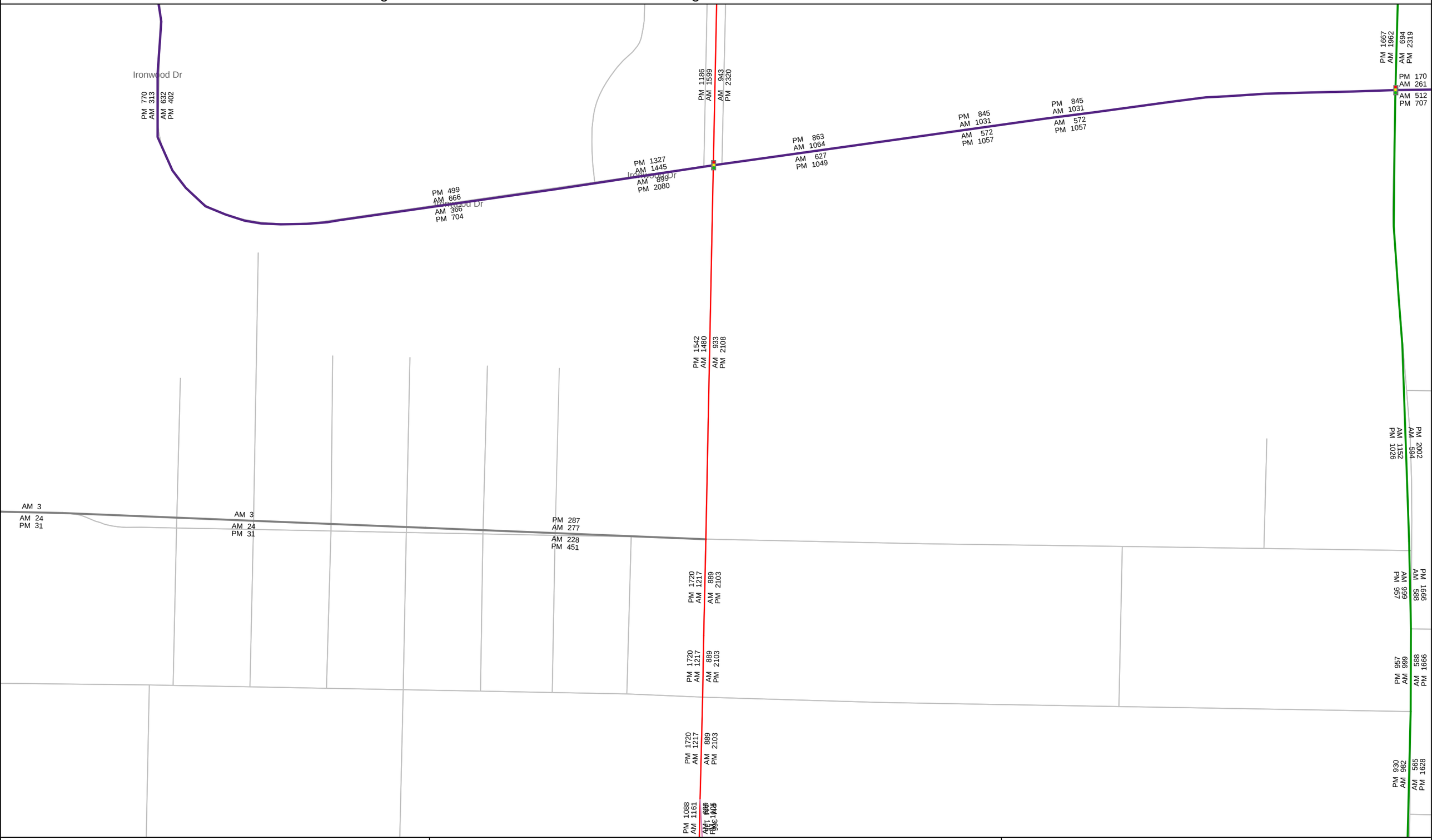
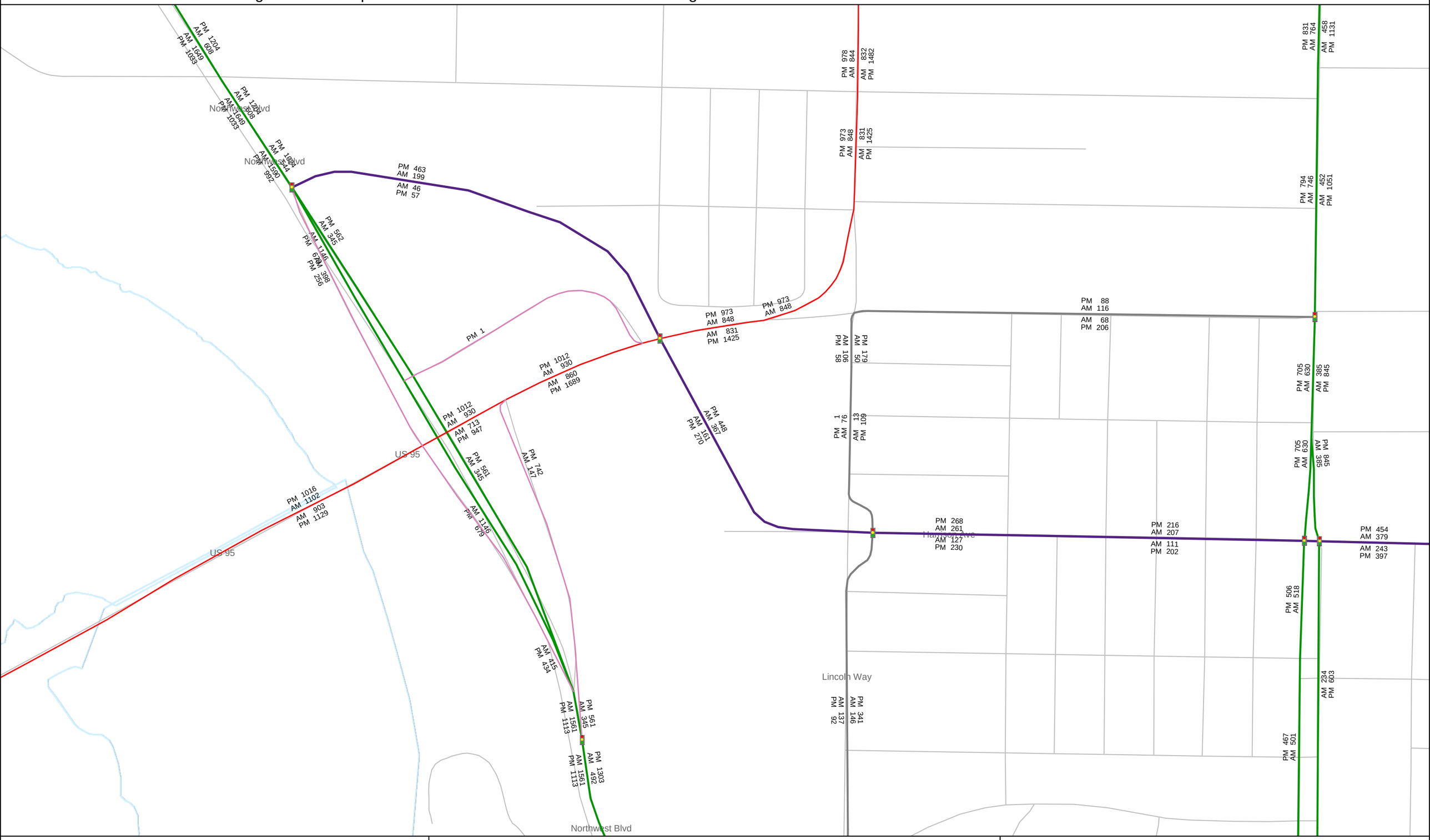
KMPO 2035 BUILD - Scenario 3 - Diamond Interchange - US 95 - AM & PM PK HR Volumes & Signals



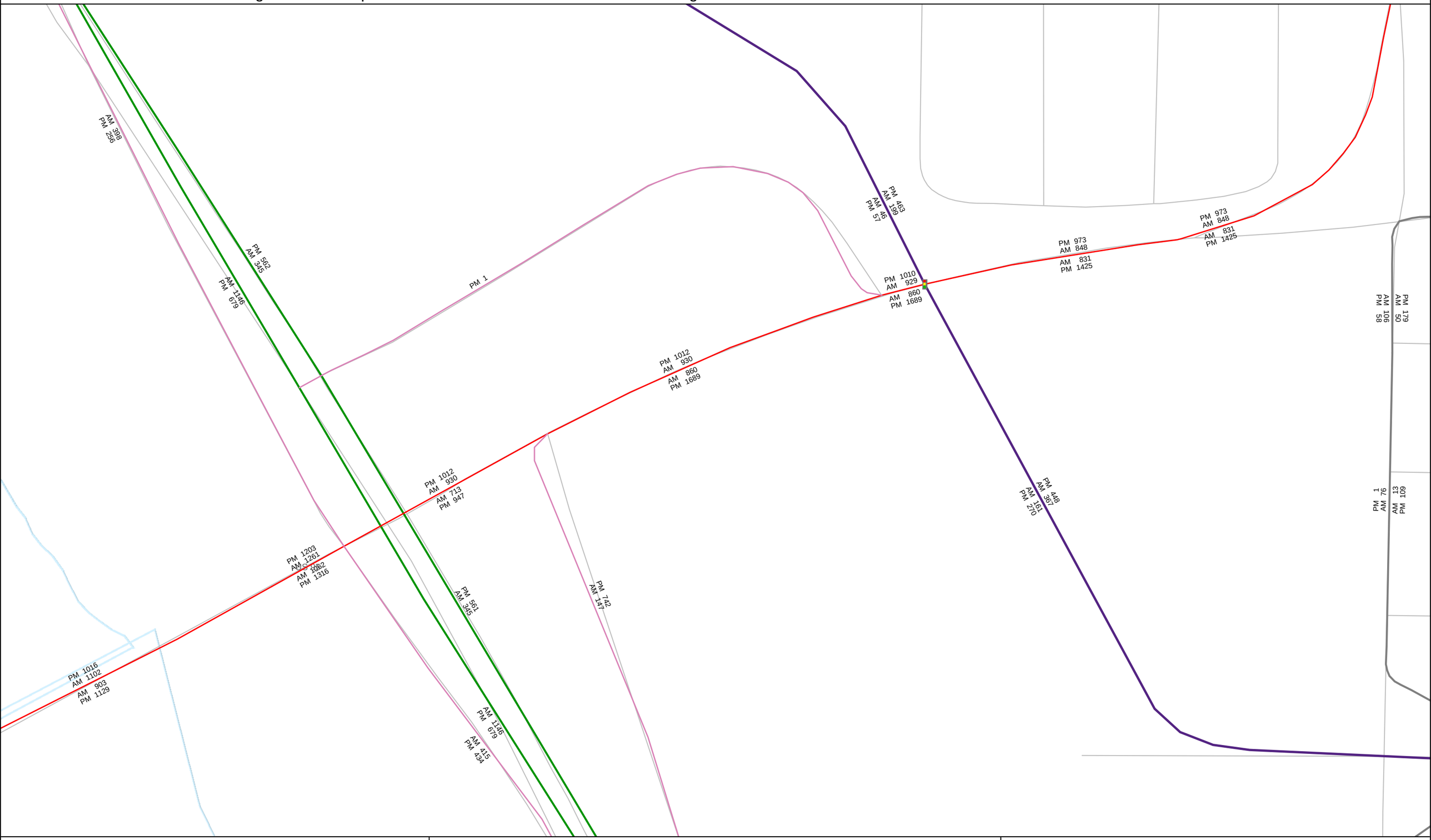
US 95, Emma to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD MODEL
Created on: 11.07.2013	KMPO_2035_BUILD_US95_Scenario3_DiamondIC_IC_7-11-13.ver	1:1972

KMPO 2020 BUILD - Scenario 4 -Signal Refined Option - US 95 - AM & PM PK HR Volumes & Signals



US 95 & NW Blvd	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 15.07.2013	KMPO_2020_BUILD_FINAL_7-15-13Signal Refined Option.ver	1:3026

KMPO 2020 BUILD - Scenario 4 -Signal Refined Option - US 95 - AM & PM PK HR Volumes & Signals



US 95 & NW Blvd Close-up	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
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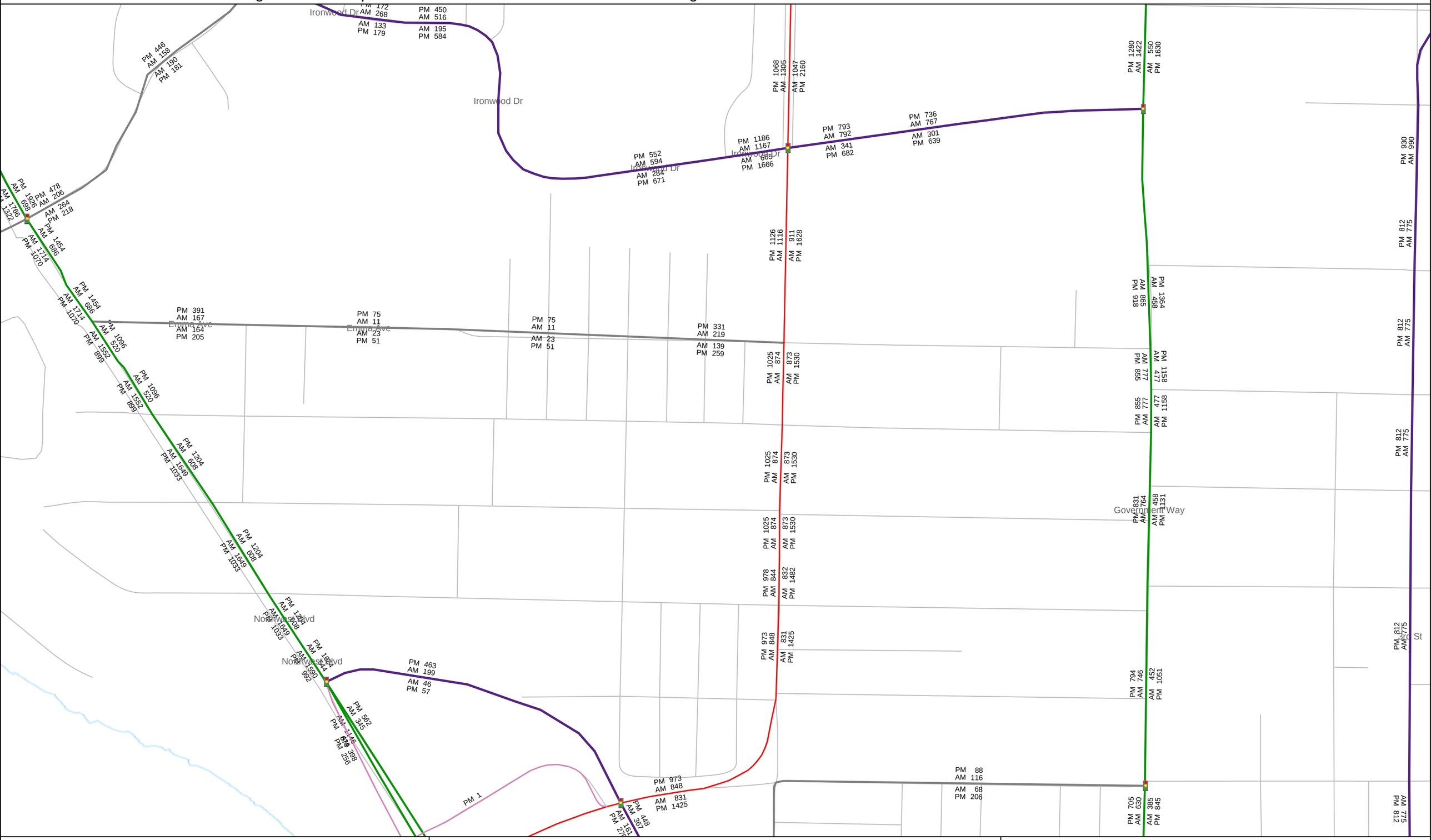
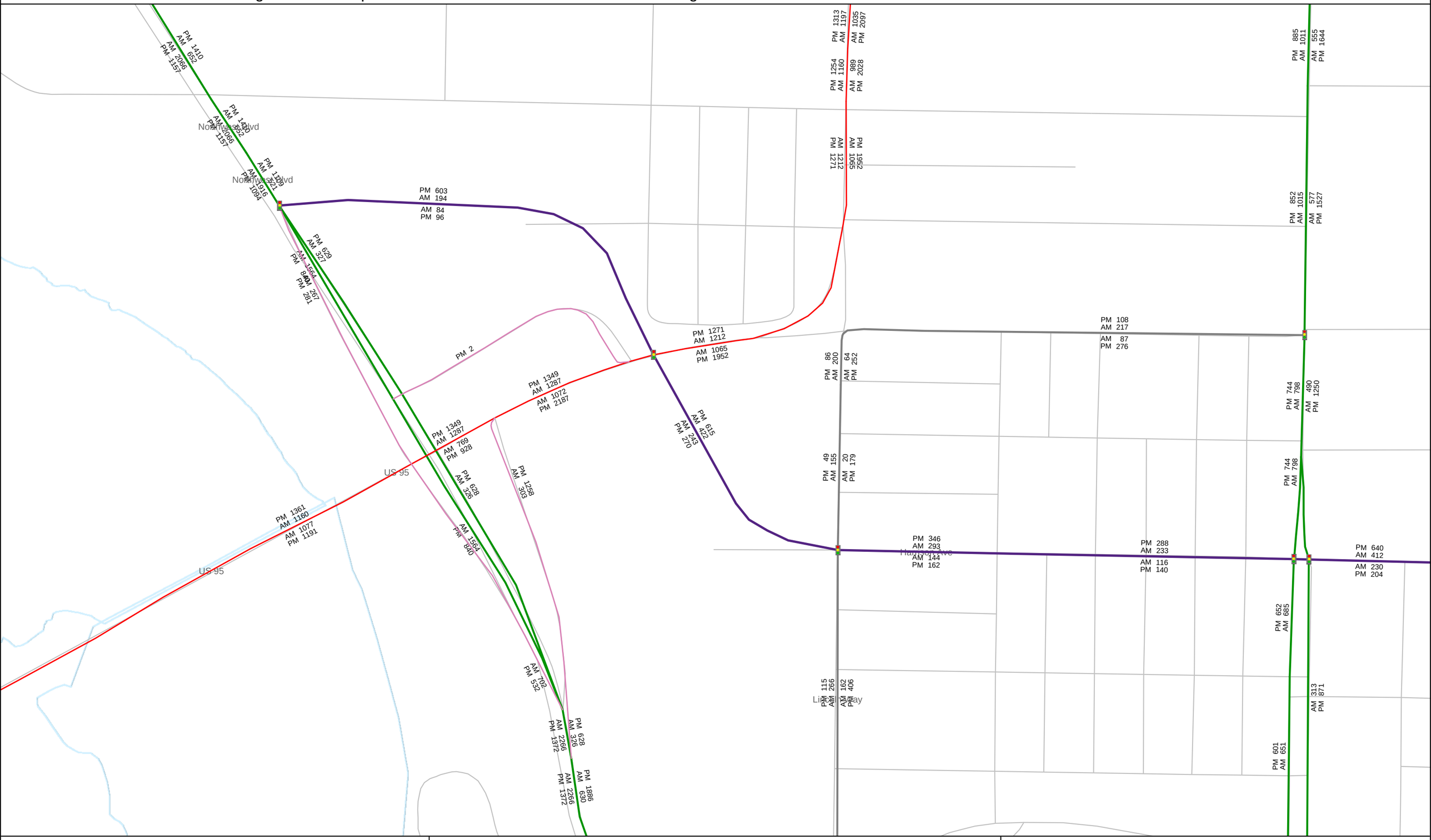
KMPO 2020 BUILD - Scenario 4 -Signal Refined Option - US 95 - AM & PM PK HR Volumes & Signals



US 95 - Walnut to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 15.07.2013	KMPO_2020_BUILD_FINAL_7-15-13Signal Refined Option.ver	1:3782

KMPO 2035 BUILD - Scenario 4 -Signal Refined Option - US 95 - AM & PM PK HR Volumes & Signals



US 95 & NW Blvd	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD MODEL
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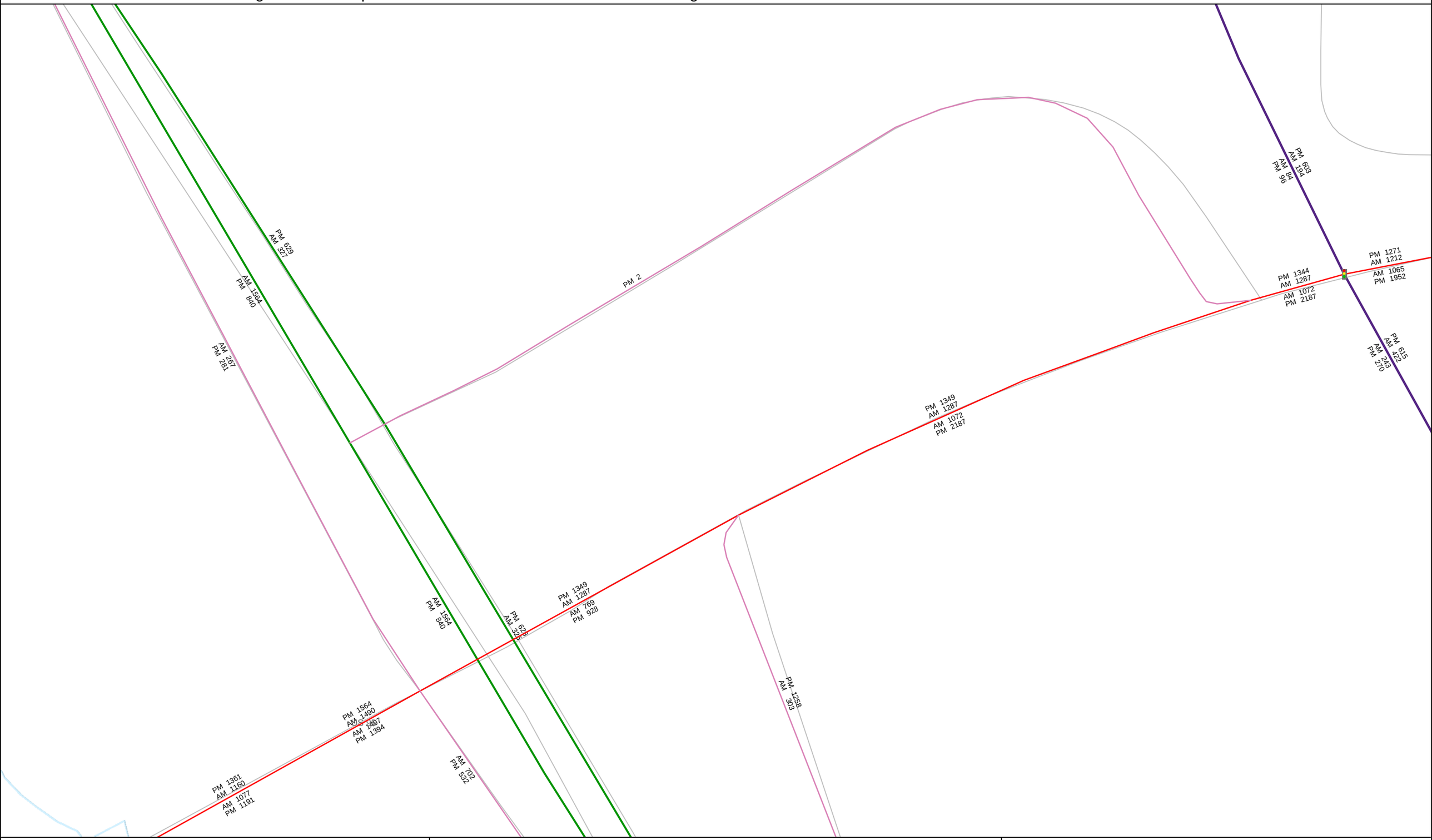
KMPO 2035 BUILD - Scenario 4 -Signal Refined Option - US 95 - AM & PM PK HR Volumes & Signals



US 95 & NW Blvd Close-up	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD MODEL
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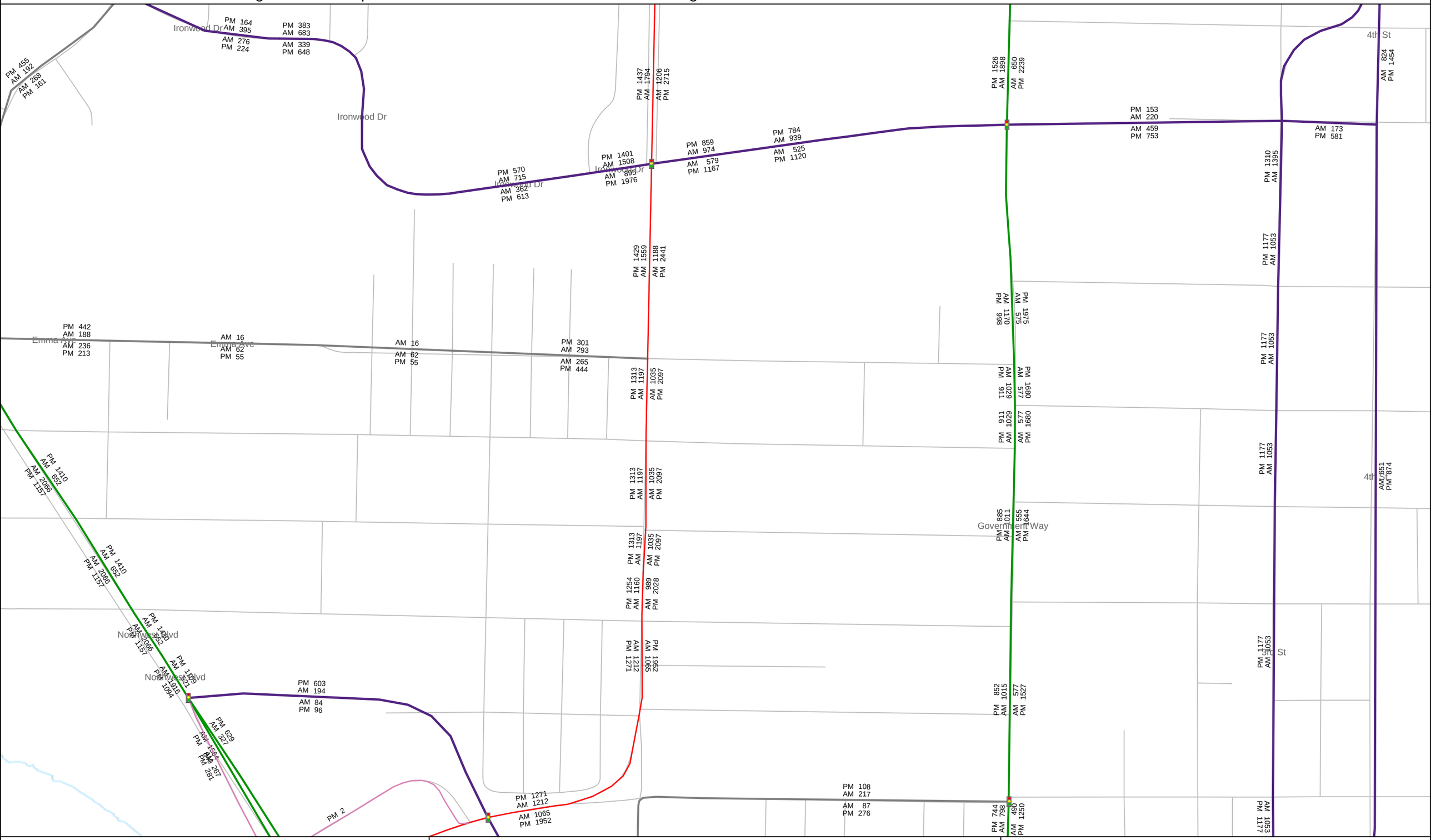
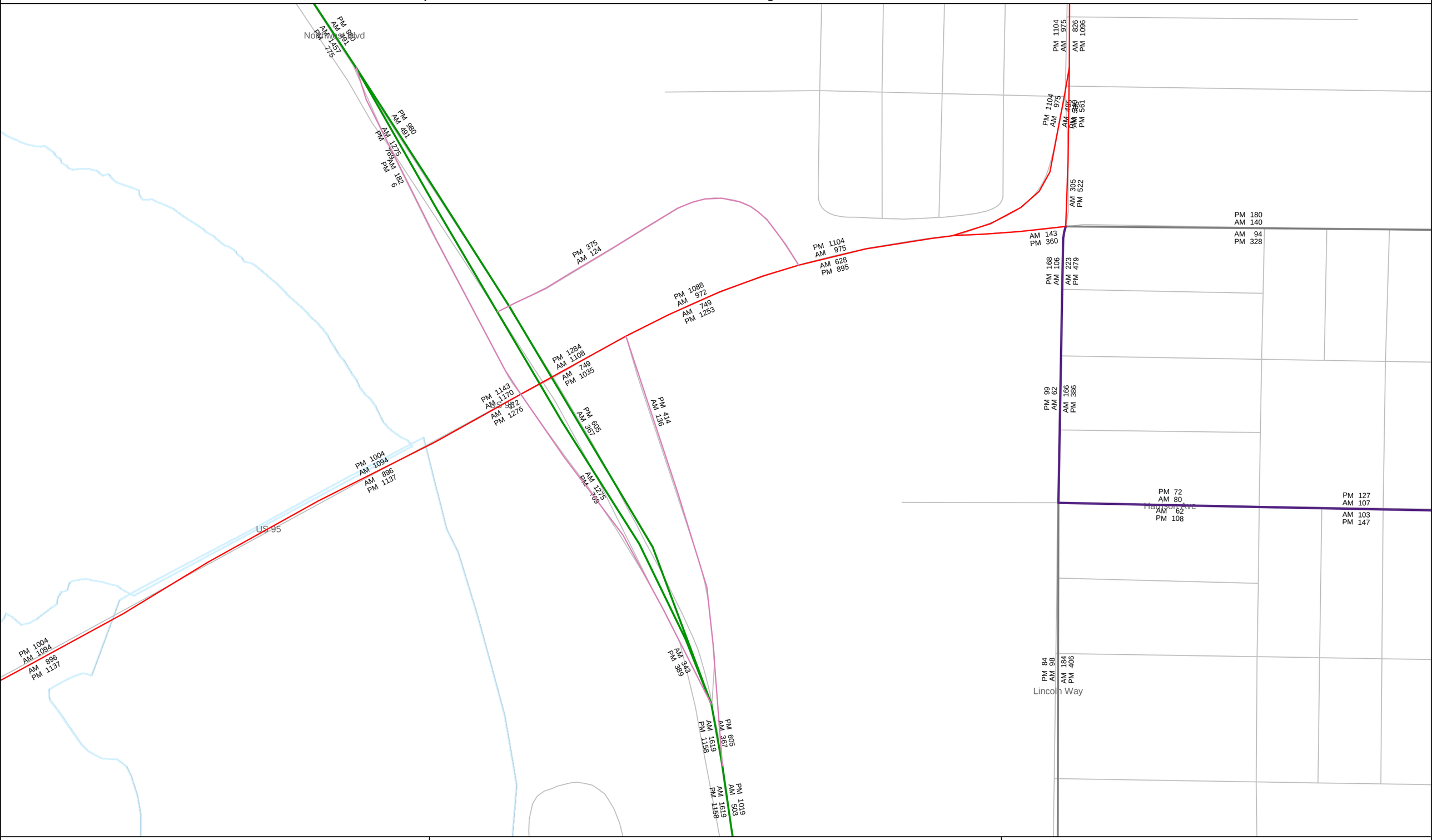
KMPO 2035 BUILD - Scenario 4 -Signal Refined Option - US 95 - AM & PM PK HR Volumes & Signals



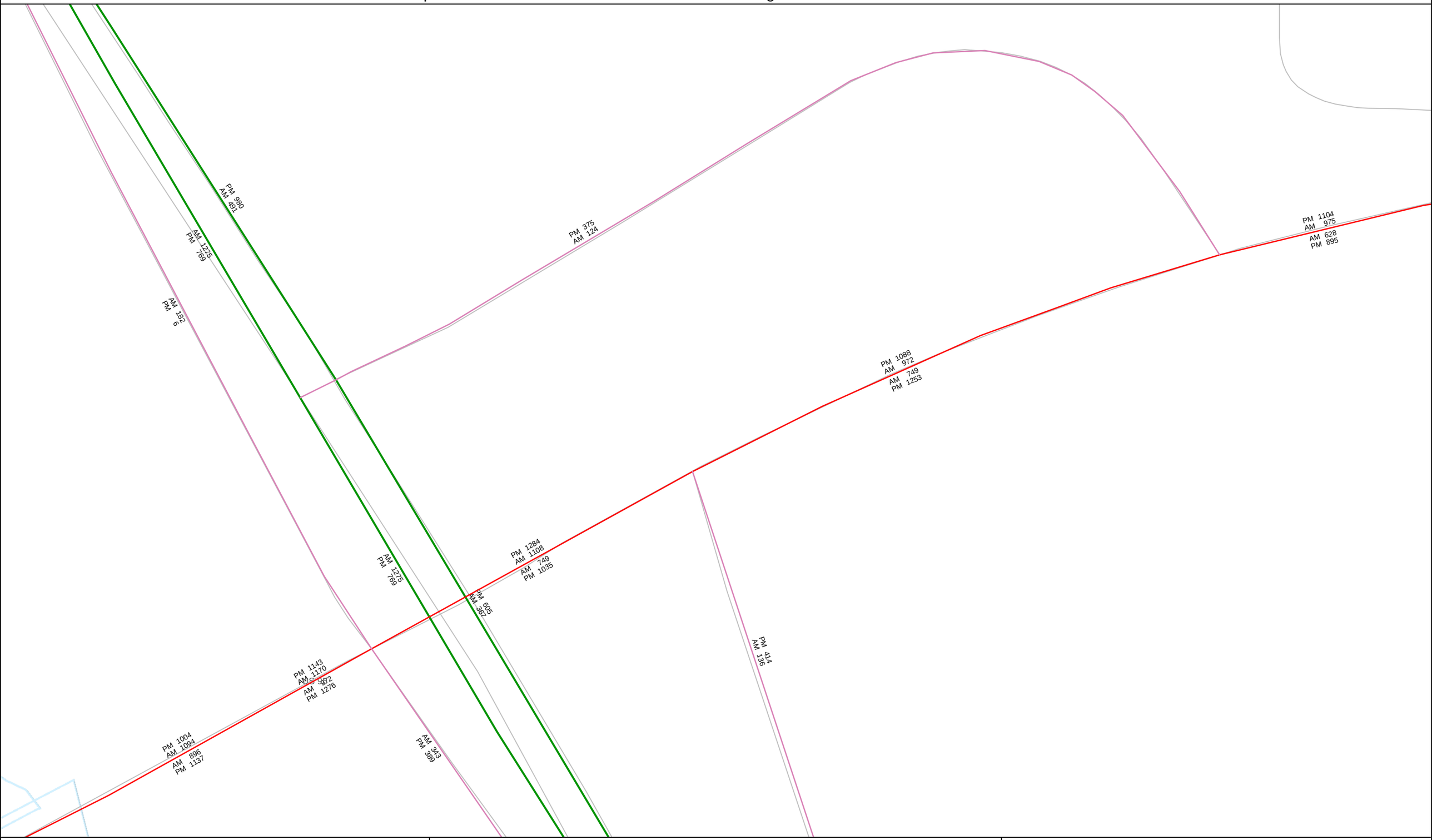
US 95- Walnut to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD MODEL
Created on: 15.07.2013	KMPO_2035_BUILD_FINAL_7-15-13Signal Refined Option.ver	1:3782

KMPO 2020 BUILD - Scenario 5a Movement Restrictions Option 1 - US 95 - AM & PM PK HR Volumes & Signals



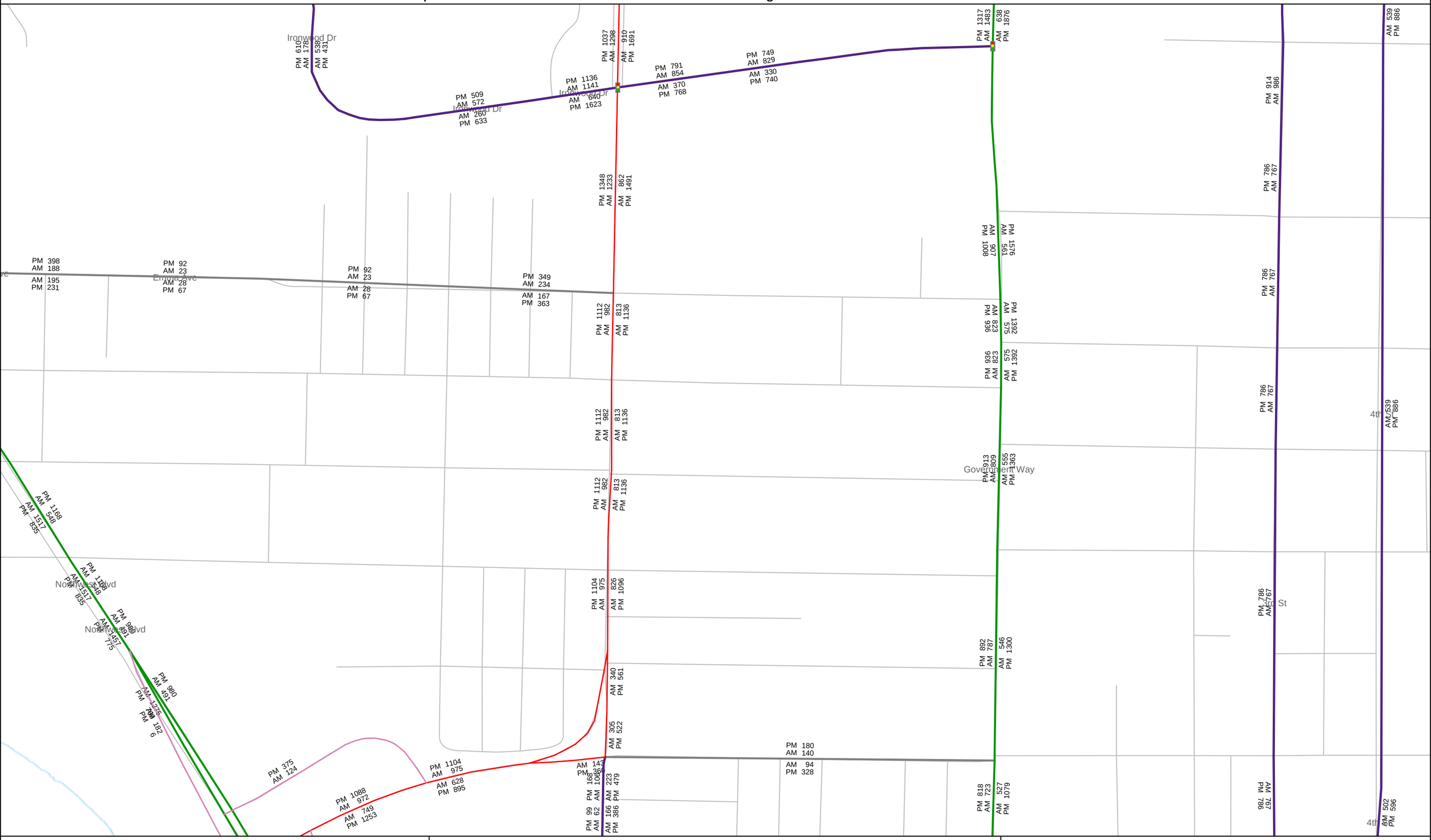
US 95 - Northwest Blvd	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 17.07.2013	2020BUILD_MovementRestrictOption1_7-16-13.ver	1:2402

KMPO 2020 BUILD - Scenario 5a Movement Restrictions Option 1 - US 95 - AM & PM PK HR Volumes & Signals



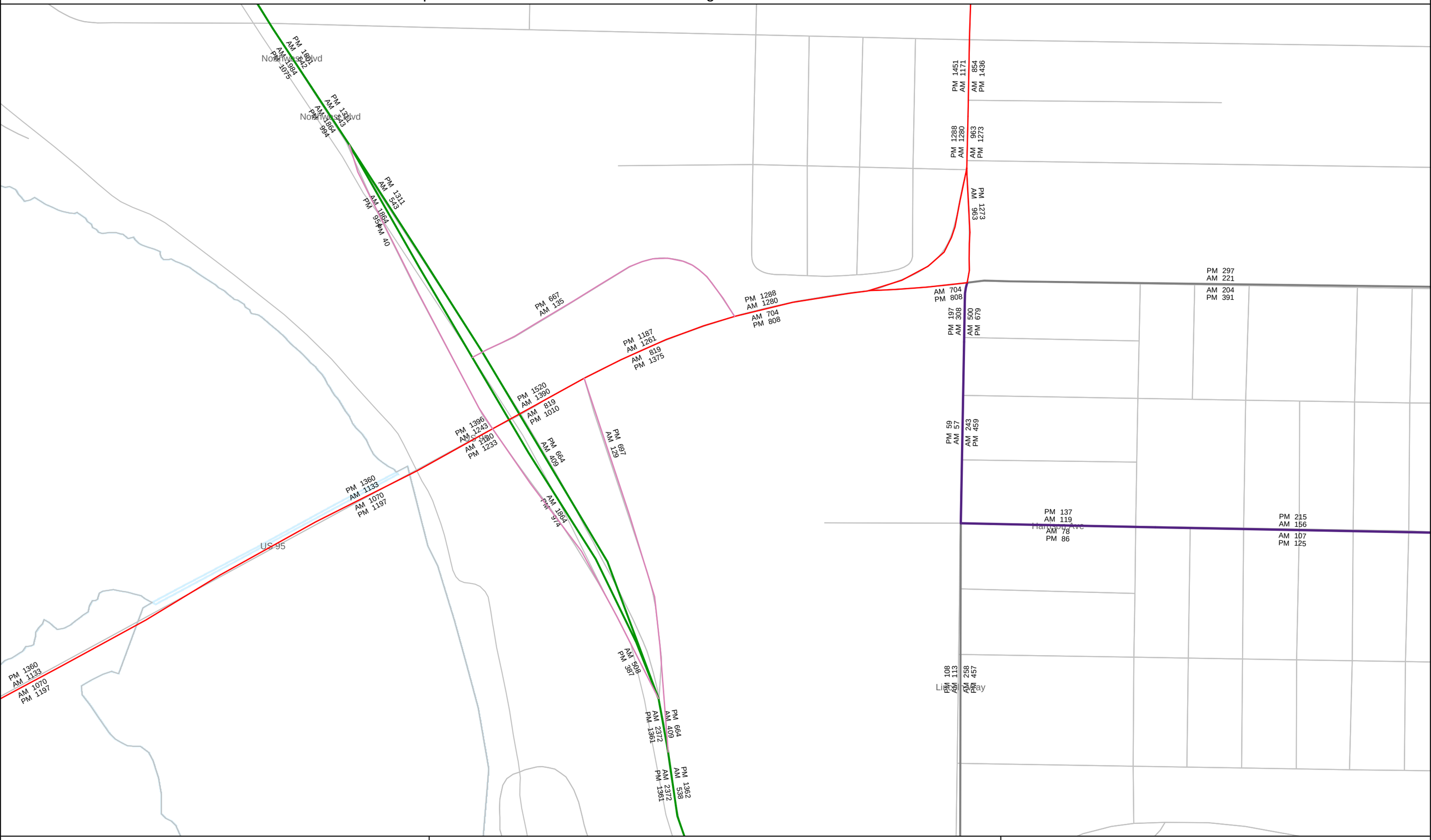
US 95 - Northwest Blvd Close-up	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 17.07.2013	2020BUILD_MovementRestrictOption1_7-16-13.ver	1:787

KMPO 2020 BUILD - Scenario 5a Movement Restrictions Option 1 - US 95 - AM & PM PK HR Volumes & Signals



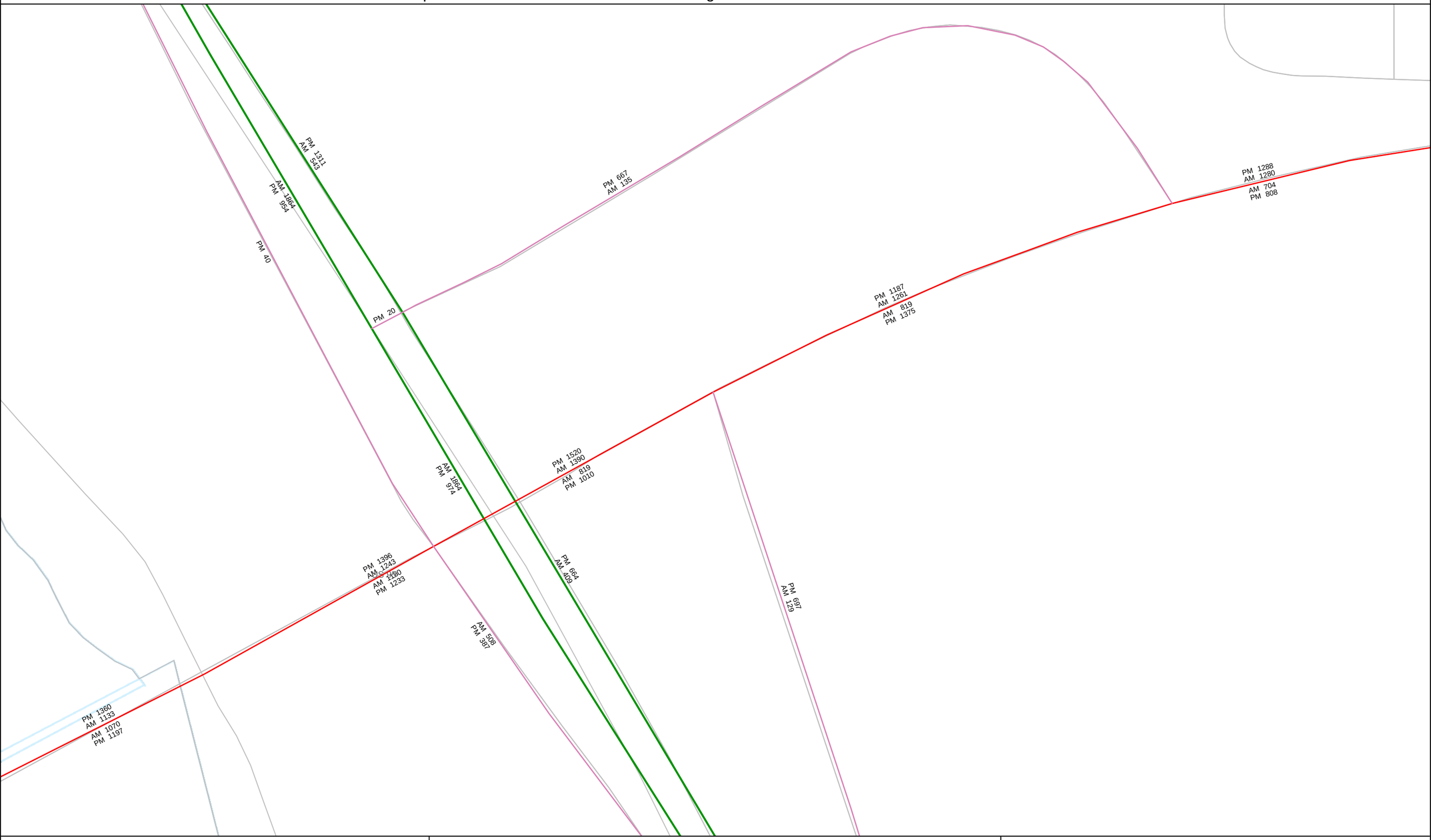
US 95 - Walnut to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 17.07.2013	2020BUILD_MovementRestrictOption1_7-16-13.ver	1:3582

KMPO 2035 BUILD - Scenario 5a Movement Restrictions Option 1 - AM & PM PK HR Volumes & Signals



US 95 - Northwest Blvd	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
Created on: 16.07.2013	KMPO_2035_BUILD_MovementRestrictOption1_7-16-13.ver	1:2755

KMPO 2035 BUILD - Scenario 5a Movement Restrictions Option 1 - AM & PM PK HR Volumes & Signals



US 95 - Northwest Blvd Close-up	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
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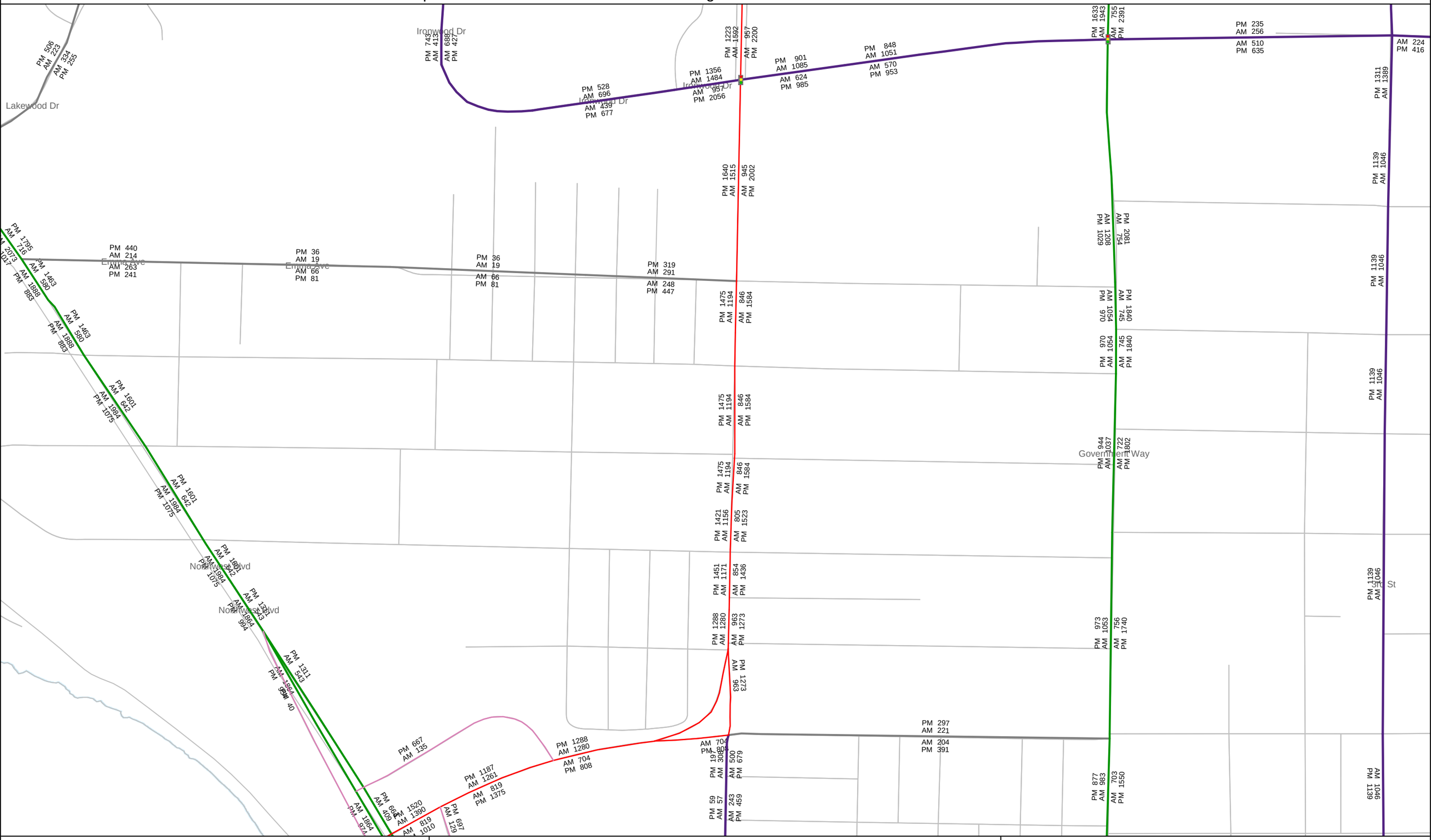
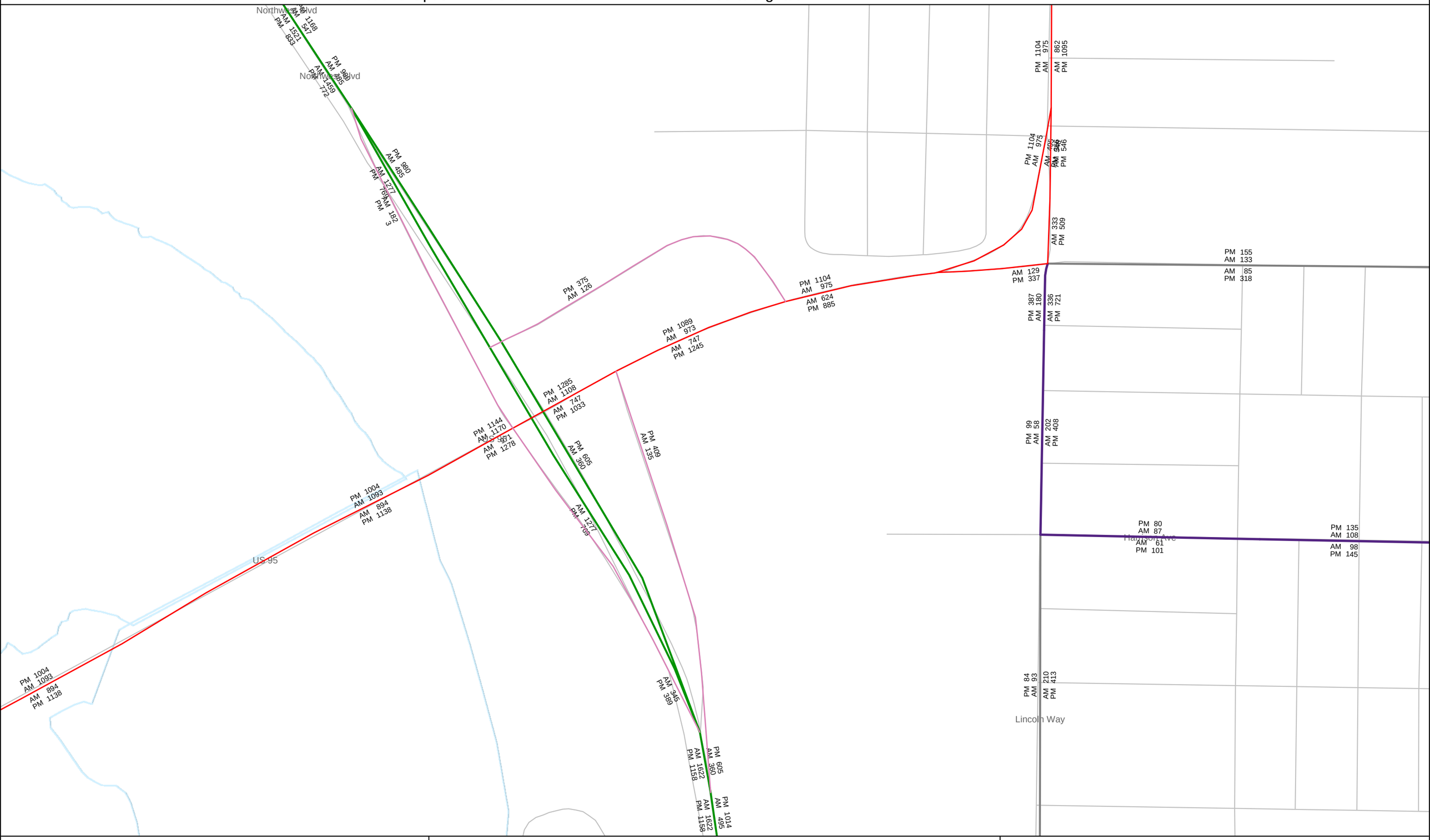
KMPO 2035 BUILD - Scenario 5a Movement Restrictions Option 1 - AM & PM PK HR Volumes & Signals



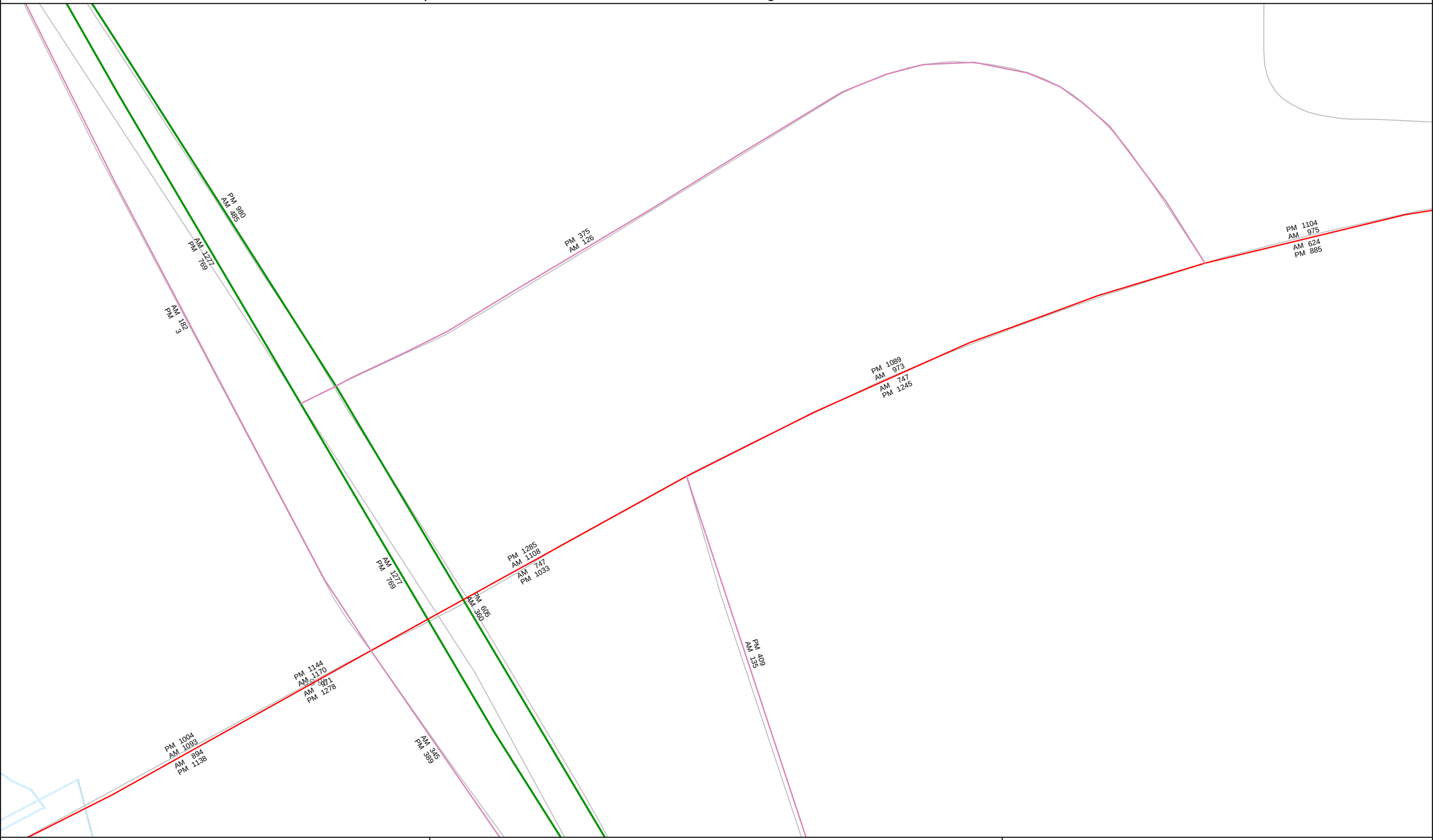
US 95 - Walnut to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
Created on: 16.07.2013	KMPO_2035_BUILD_MovementRestrictOption1_7-16-13.ver	1:3660

KMPO 2020 BUILD - Scenario 5b Movement Restrictions Option 2 - US 95 - AM & PM PK HR Volumes & Signals



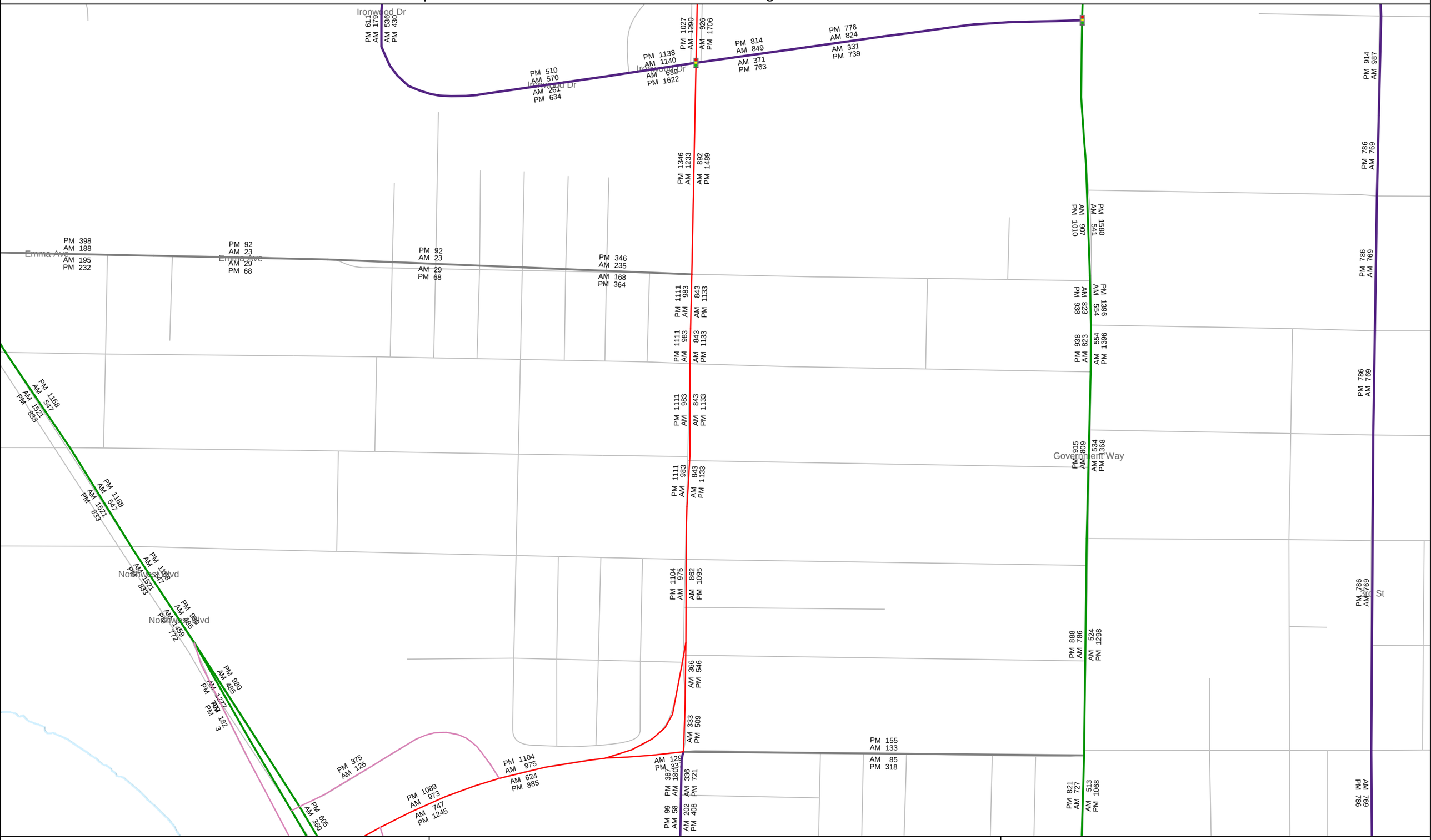
US 95 - Nortwest Blvd	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 16.07.2013	2020BUILD_MovementRestrictOption2_7-16-13.ver	1:2444

KMPO 2020 BUILD - Scenario 5b Movement Restrictions Option 2 - US 95 - AM & PM PK HR Volumes & Signals



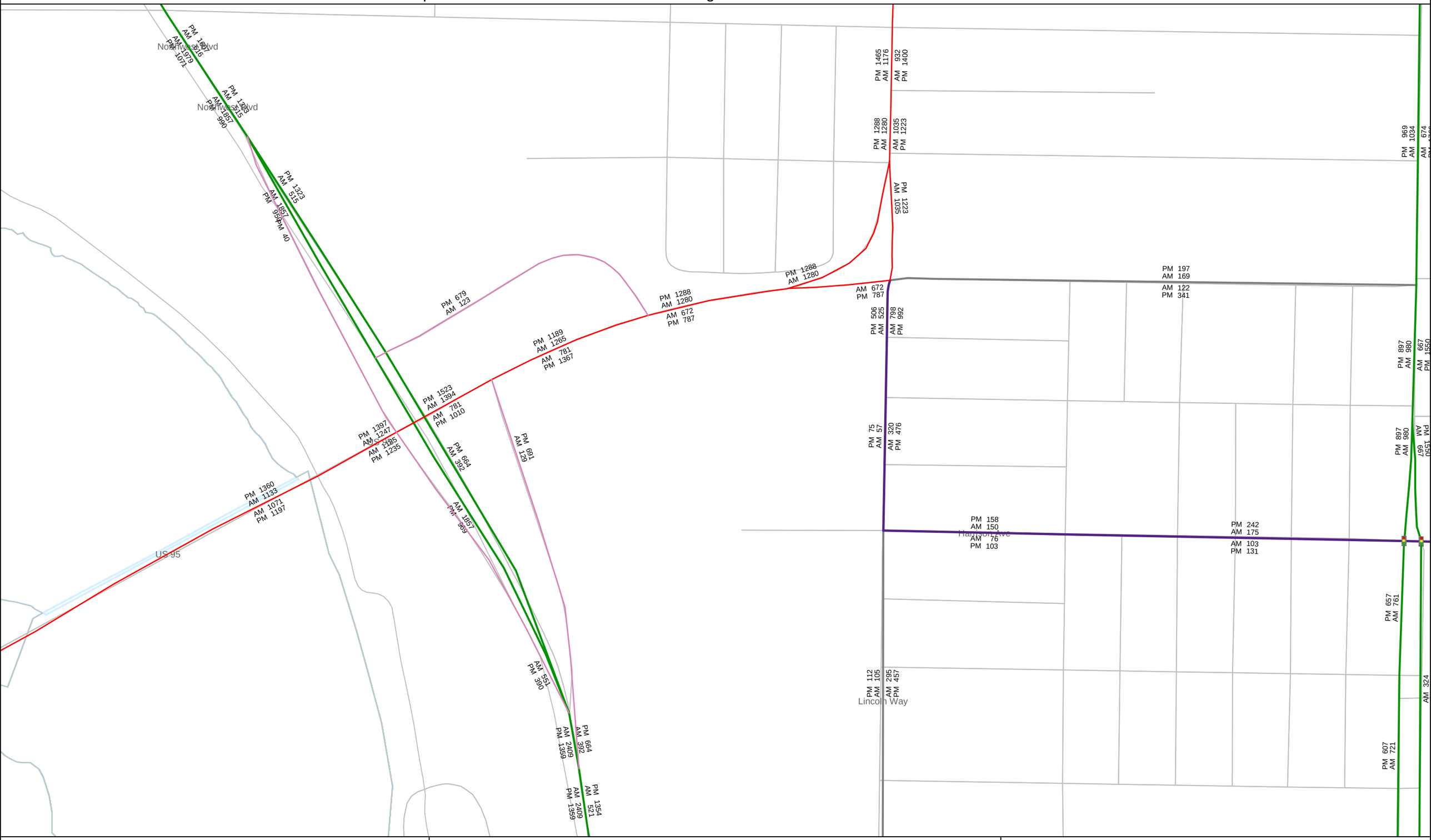
US 95 - Nortwest Blvd	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 16.07.2013	2020BUILD_MovementRestrictOption2_7-16-13.ver	1:801

KMPO 2020 BUILD - Scenario 5b Movement Restrictions Option 2 - US 95 - AM & PM PK HR Volumes & Signals



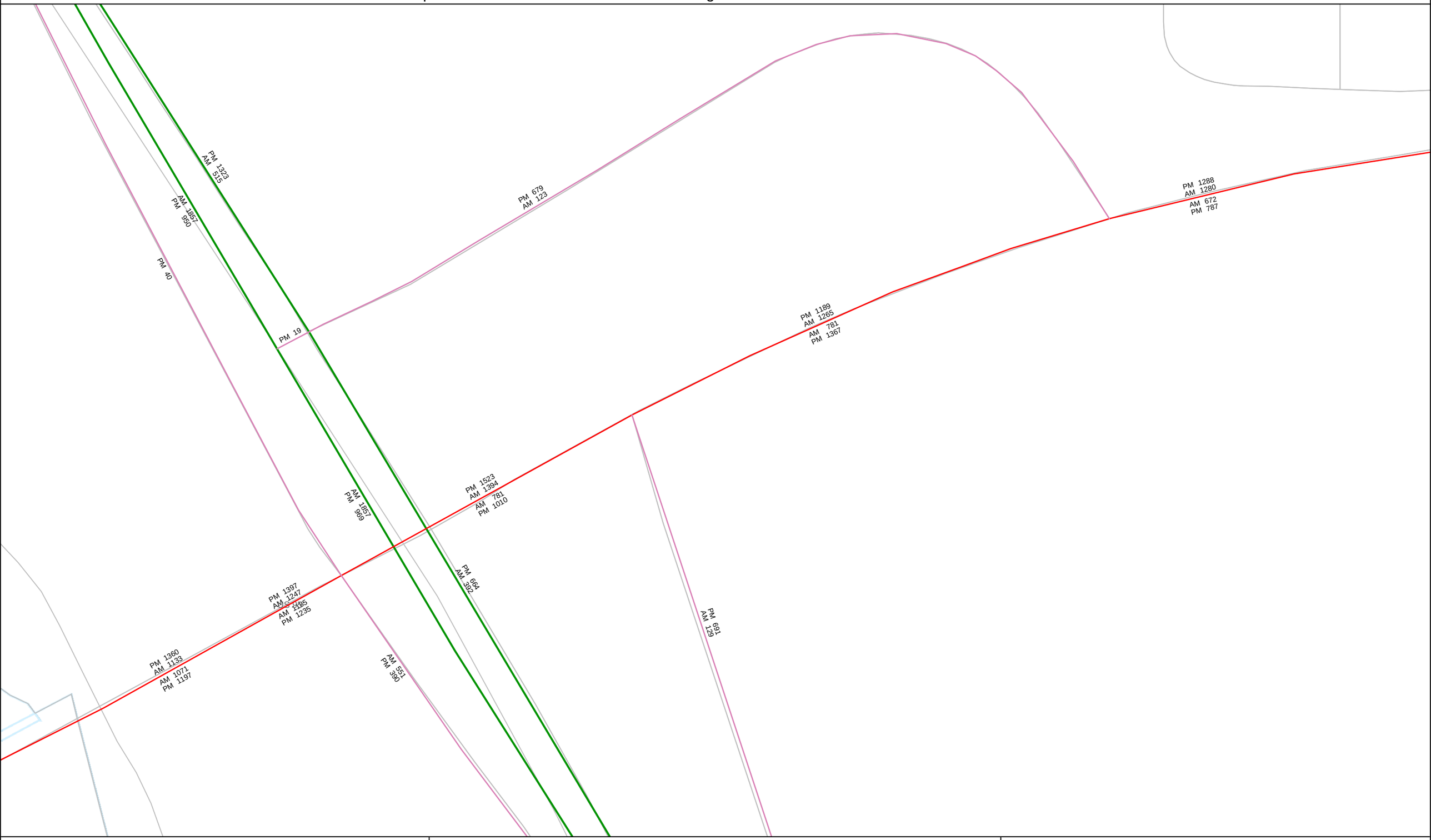
US 95 - Walnut to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 16.07.2013	2020BUILD_MovementRestrictOption2_7-16-13.ver	1:3480

KMPO 2035 BUILD - Scenario 5b Movement Restrictions Option 2 - AM & PM PK HR Volumes & Signals



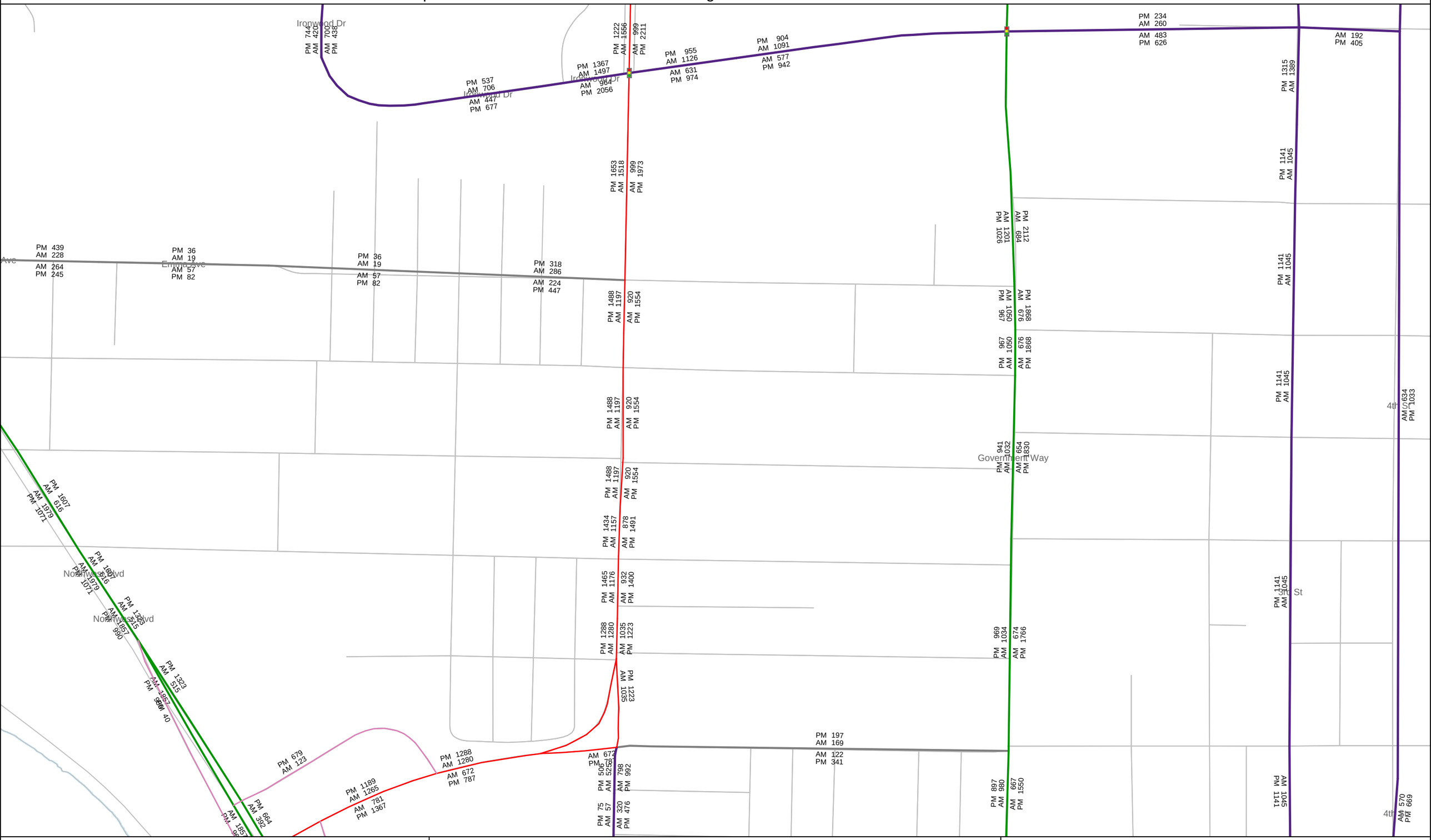
US 95 - Northwest Blvd	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
Created on: 16.07.2013	KMPO_2035_BUILD_MovementRestrictOption2_7-16-13.ver	1:2650

KMPO 2035 BUILD - Scenario 5b Movement Restrictions Option 2 - AM & PM PK HR Volumes & Signals



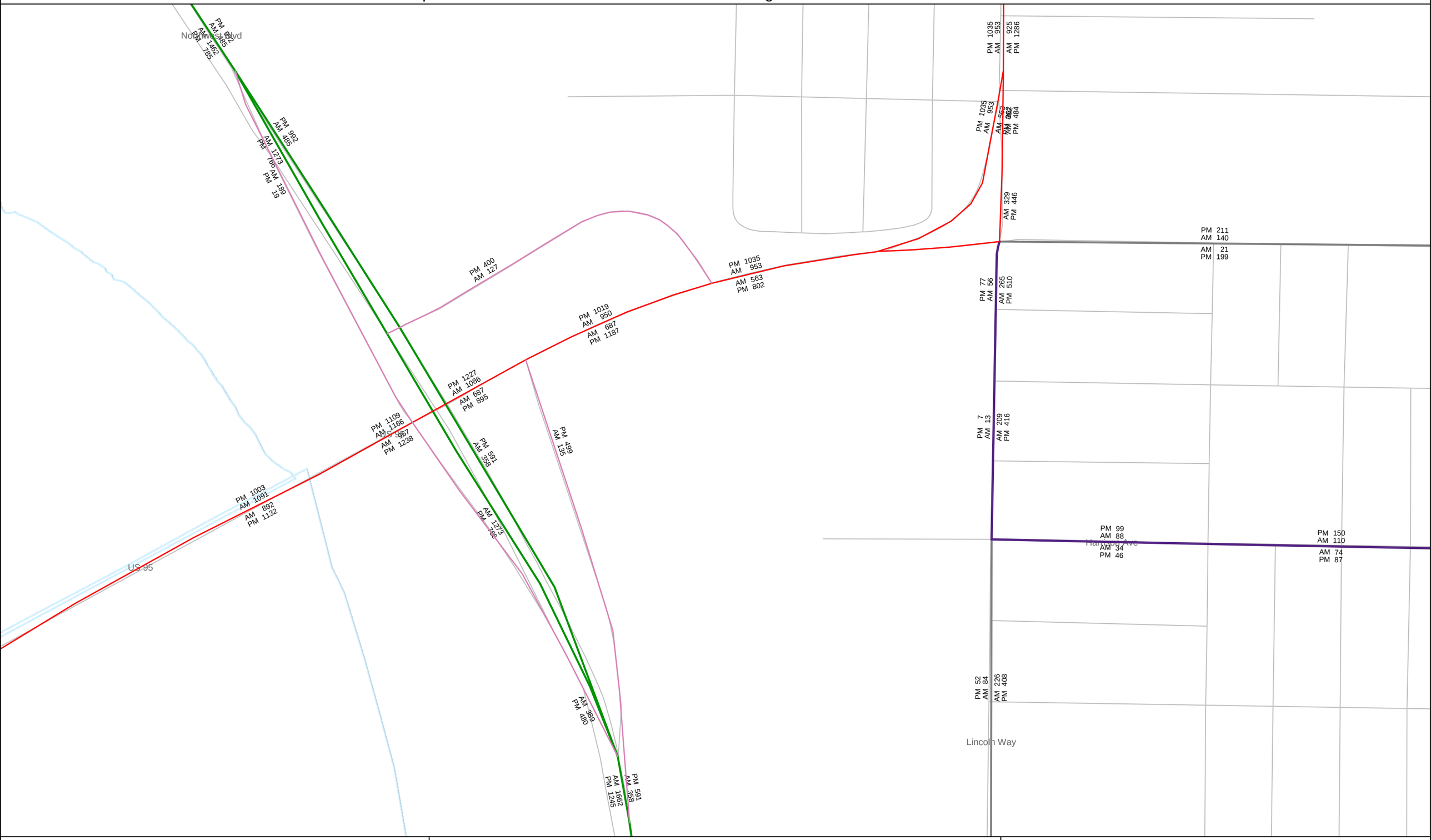
US 95 - Northwest Blvd Close-up	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
Created on: 16.07.2013	KMPO_2035_BUILD_MovementRestrictOption2_7-16-13.ver	1:868

KMPO 2035 BUILD - Scenario 5b Movement Restrictions Option 2 - AM & PM PK HR Volumes & Signals



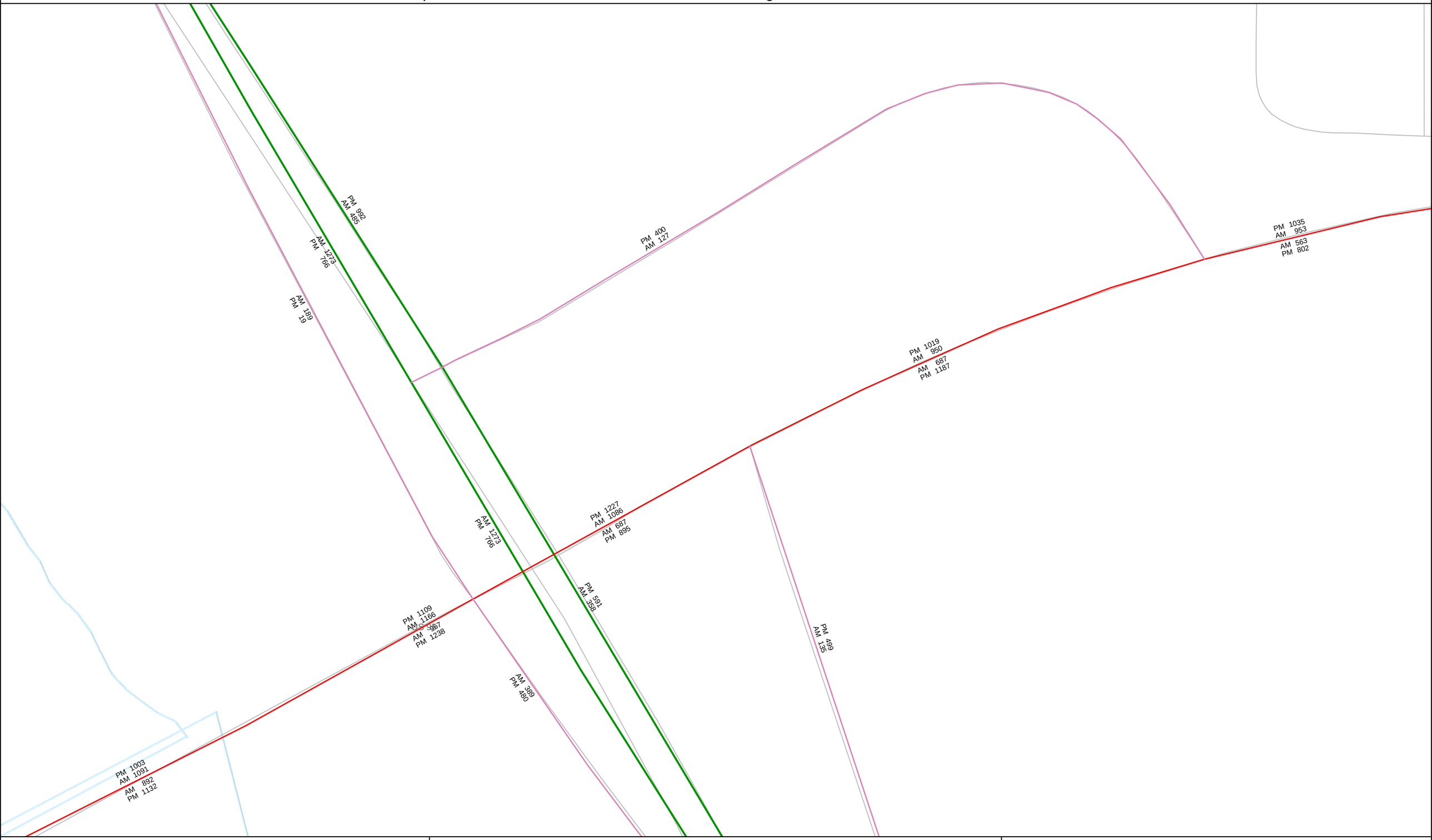
US 95 - Walnut to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
Created on: 16.07.2013	KMPO_2035_BUILD_MovementRestrictOption2_7-16-13.ver	1:3559

KMPO 2020 BUILD - Scenario 5c Movement Restrictions Option 3 - US 95 - AM & PM PK HR Volumes & Signals



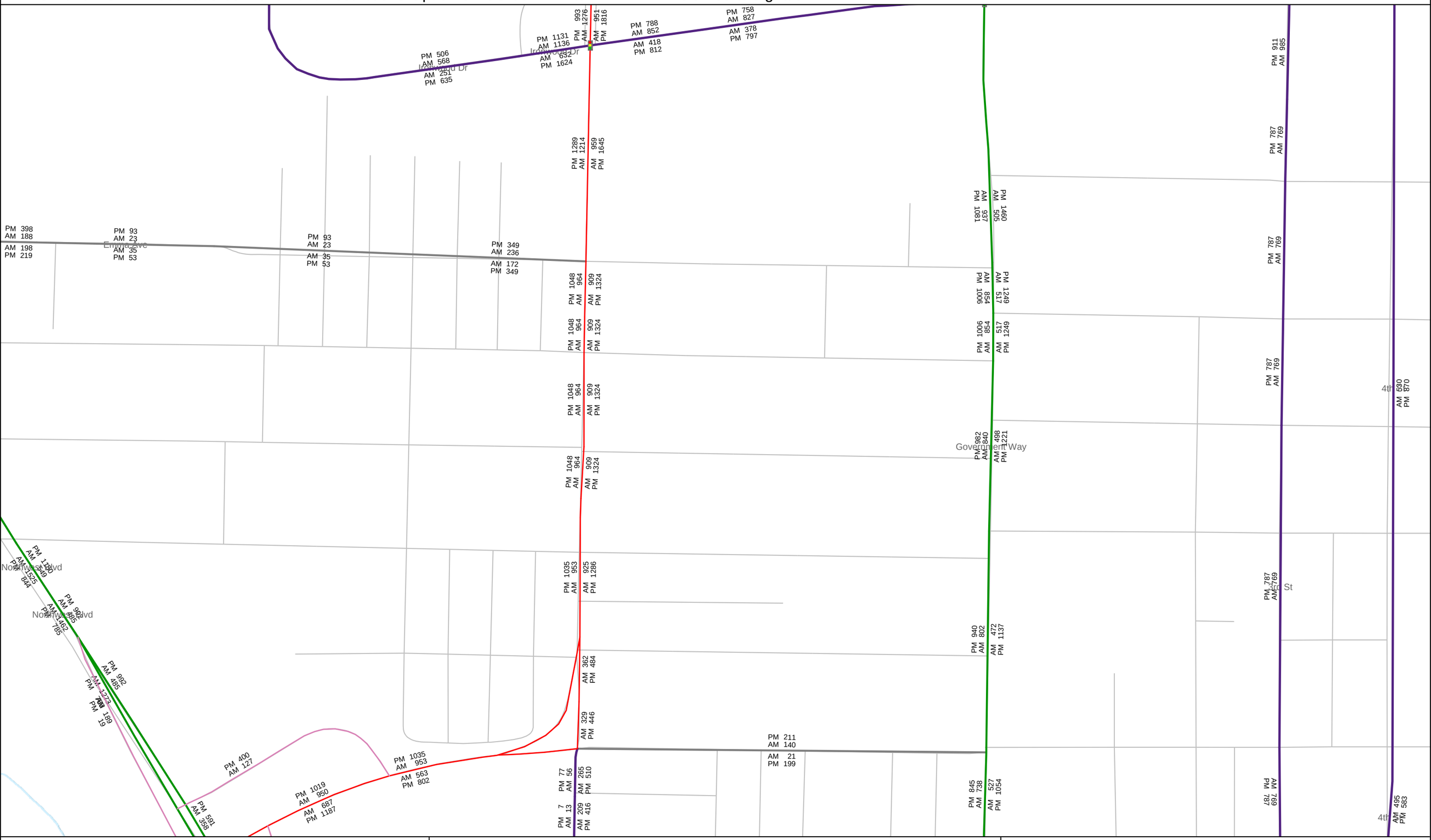
US 95 - Northwest Blvd	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 16.07.2013	2020BUILD_MovementRestrictOption3_7-16-13.ver	1:2227

KMPO 2020 BUILD - Scenario 5c Movement Restrictions Option 3 - US 95 - AM & PM PK HR Volumes & Signals



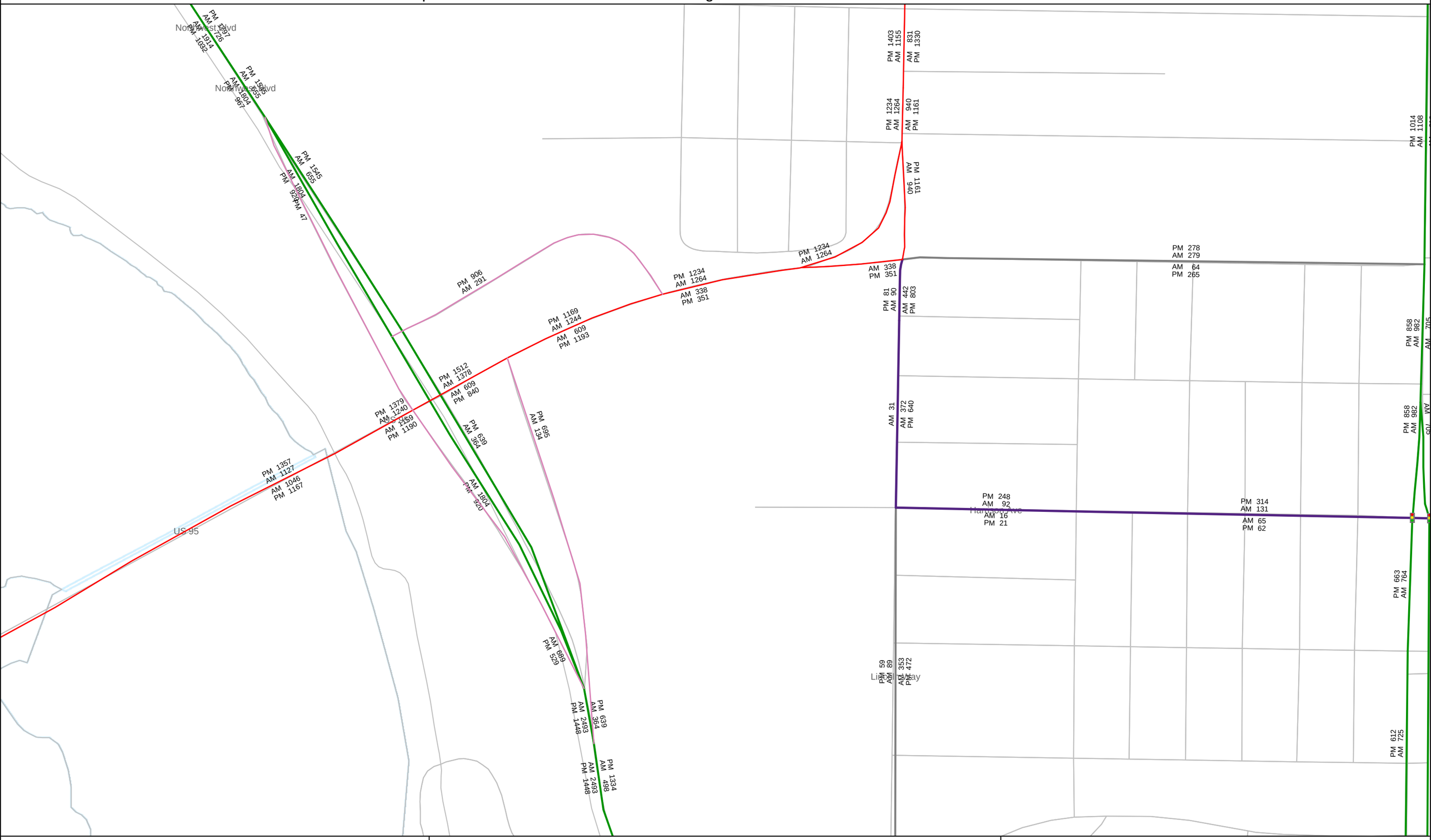
US 95 - Northwest Blvd Close-up	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 16.07.2013	2020BUILD_MovementRestrictOption3_7-16-13.ver	1:912

KMPO 2020 BUILD - Scenario 5c Movement Restrictions Option 3 - US 95 - AM & PM PK HR Volumes & Signals



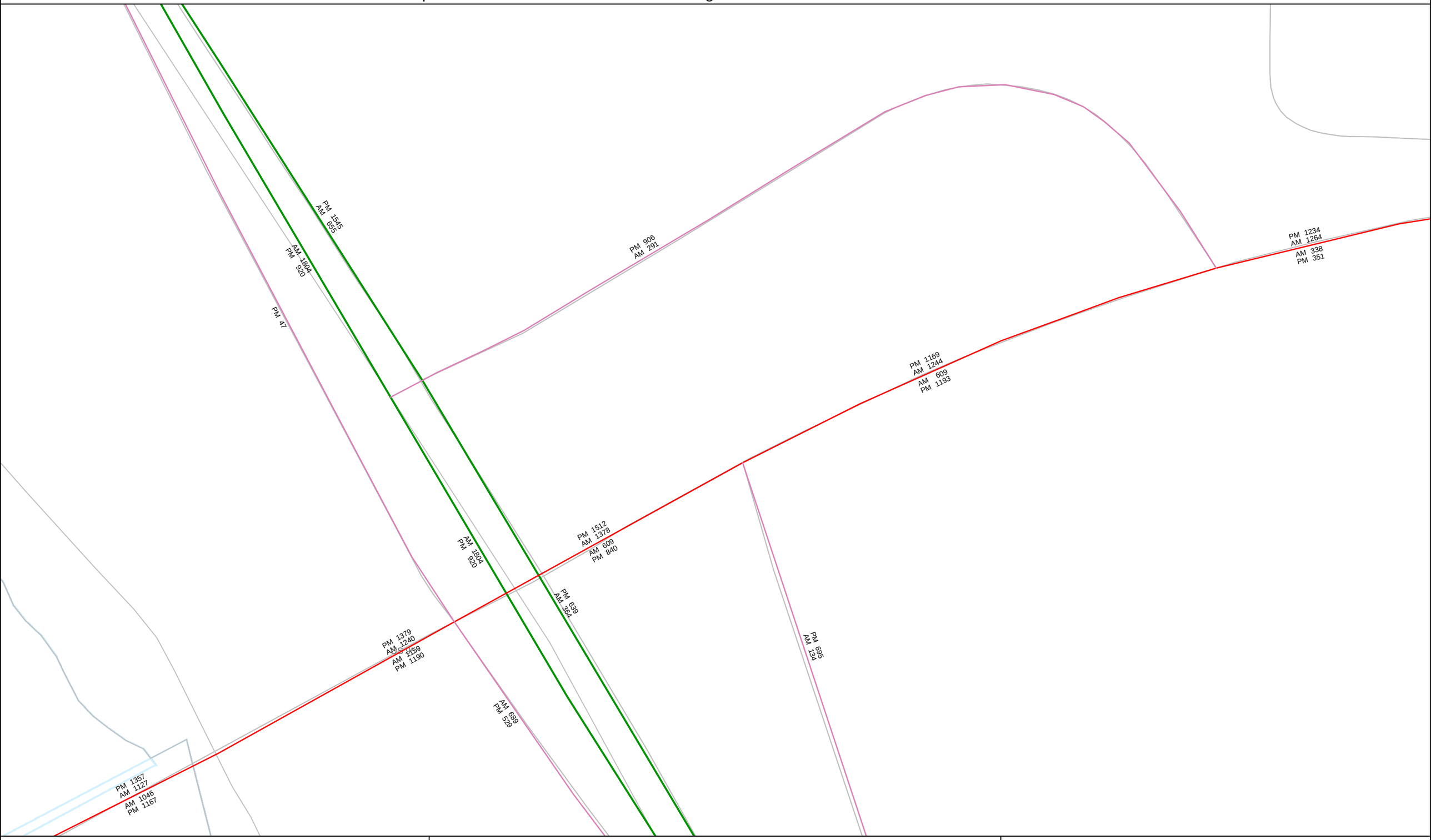
US 95 - Walnut to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL
Created on: 16.07.2013	2020BUILD_MovementRestrictOption3_7-16-13.ver	1:3410

KMPO 2035 BUILD - Scenario 5c Movement Restrictions Option 3 - AM & PM PK HR Volumes & Signals



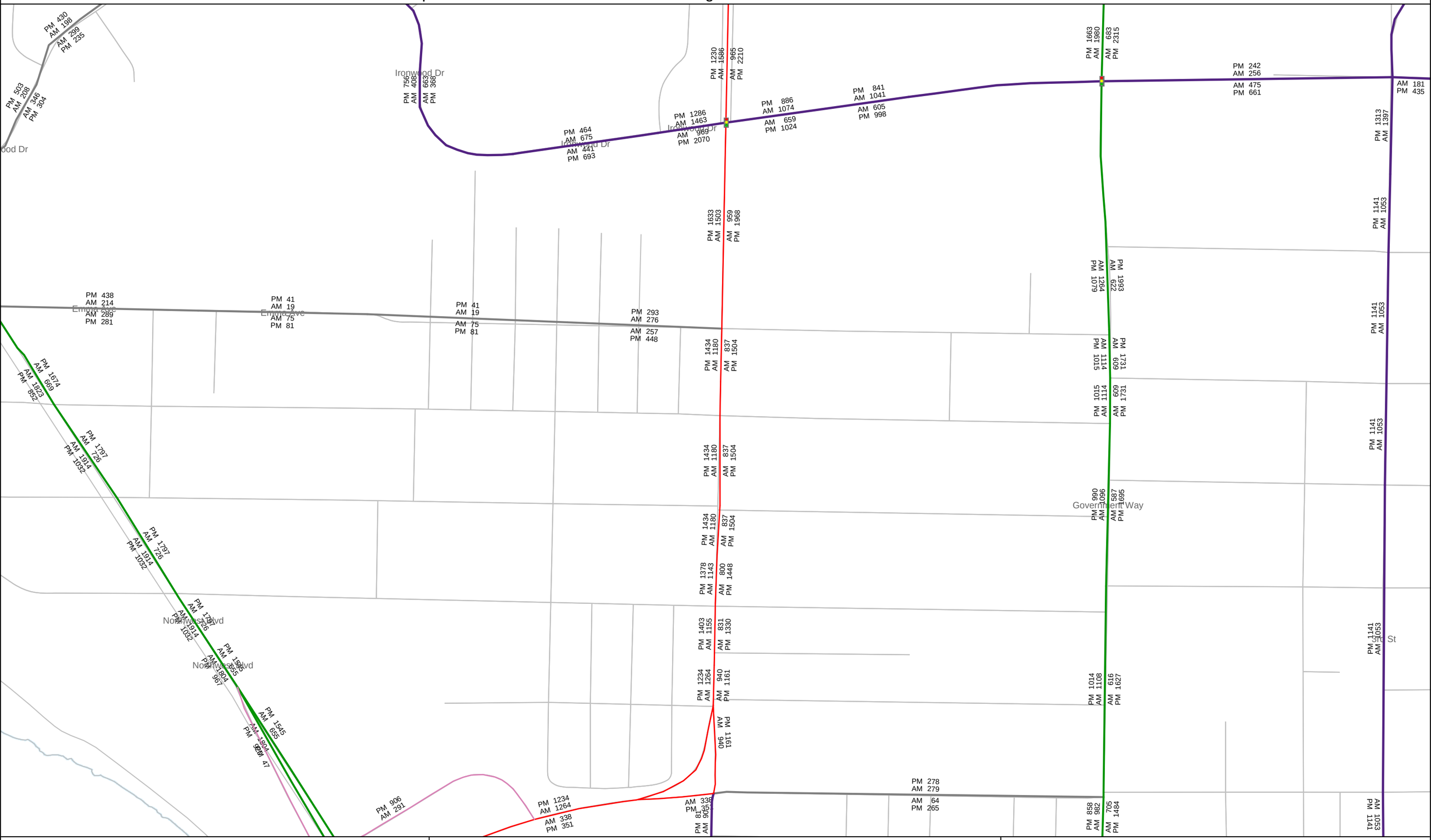
US 95 - Northwest Blvd	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
Created on: 16.07.2013	KMPO_2035_BUILD_MovementRestrictOption3_7-16-13.ver	1:2671

KMPO 2035 BUILD - Scenario 5c Movement Restrictions Option 3 - AM & PM PK HR Volumes & Signals



US 95 - Northwest Blvd Close-up	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
Created on: 16.07.2013	KMPO_2035_BUILD_MovementRestrictOption3_7-16-13.ver	1:875

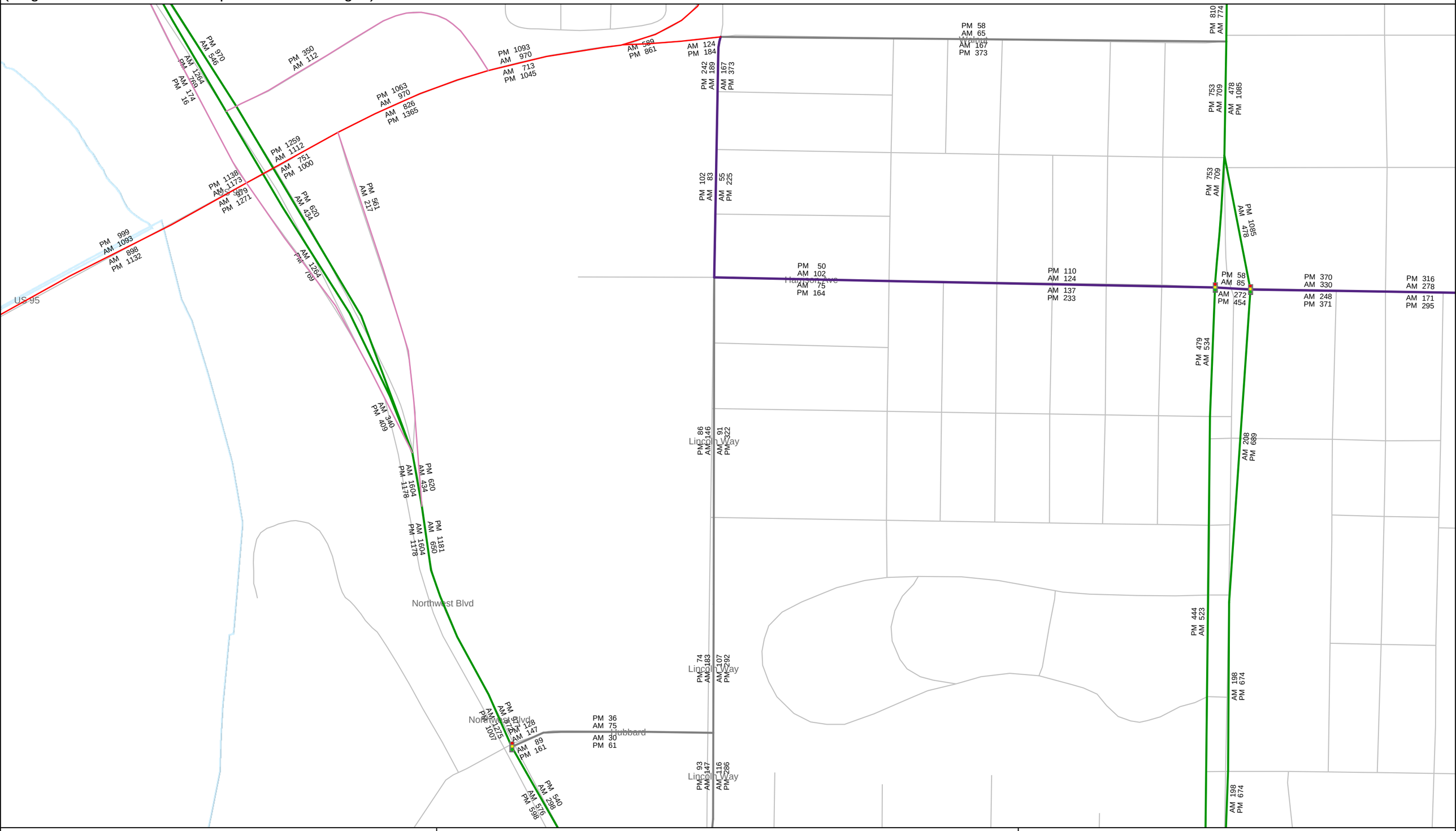
KMPO 2035 BUILD - Scenario 5c Movement Restrictions Option 3 - AM & PM PK HR Volumes & Signals



US 95 - Walnut to Ironwood	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD
Created on: 16.07.2013	KMPO_2035_BUILD_MovementRestrictOption3_7-16-13.ver	1:3577

KMPO 2020 BUILD - Scenario 5d Movement Restrictions Option B - US 95 - AM & PM PK HR Volumes & Signals

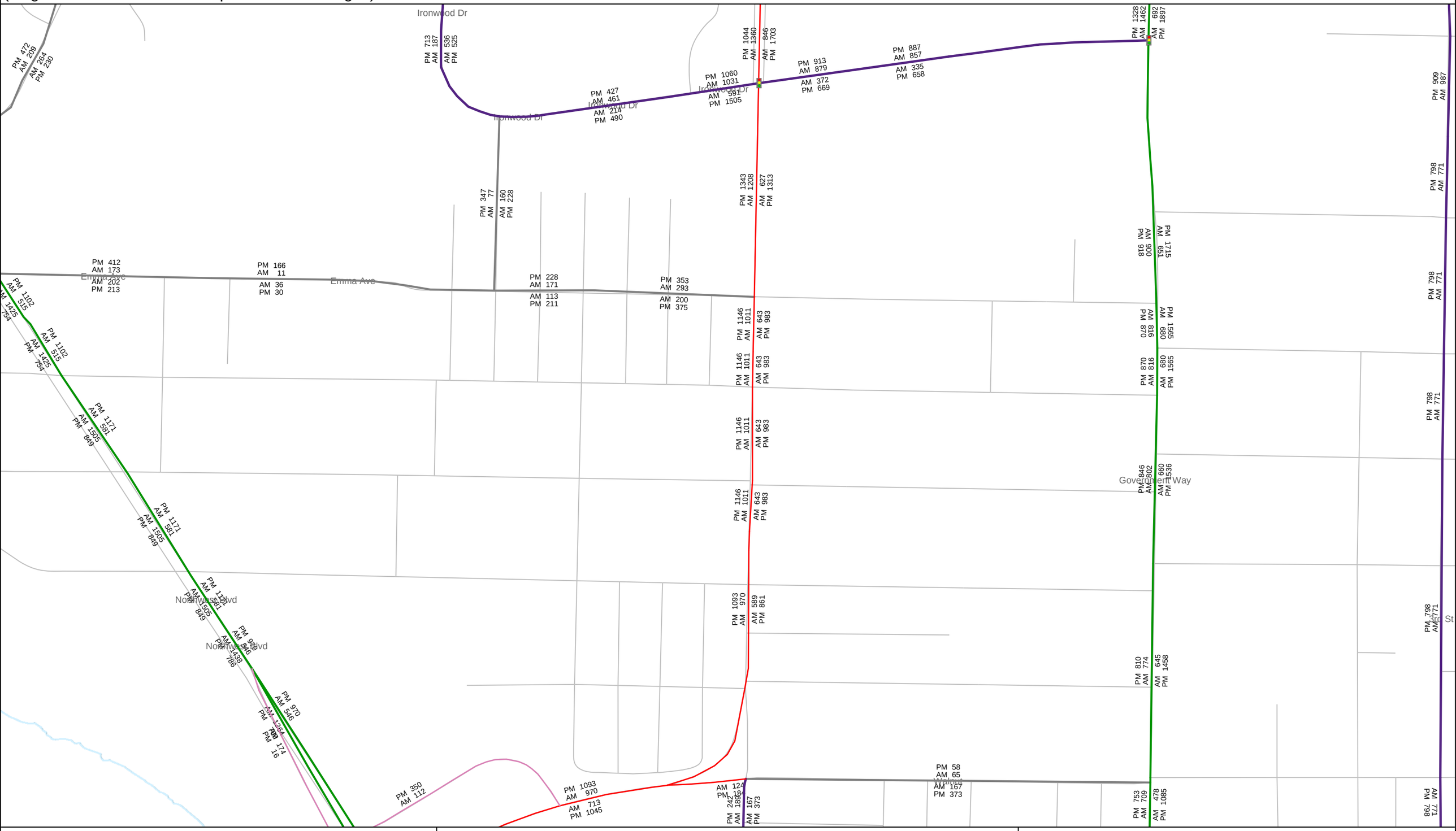
(Original Movement Restrict Option 2 with Changes)



US 95 - Hubbard to Walnut	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL- Option B
Created on: 11.09.2013	2020BUILD_Scen_8_MoveRestrictOption2NewOptionB_9-11-13.ver	1:2806

KMPO 2020 BUILD - Scenario 5d Movement Restrictions Option B - US 95 - AM & PM PK HR Volumes & Signals

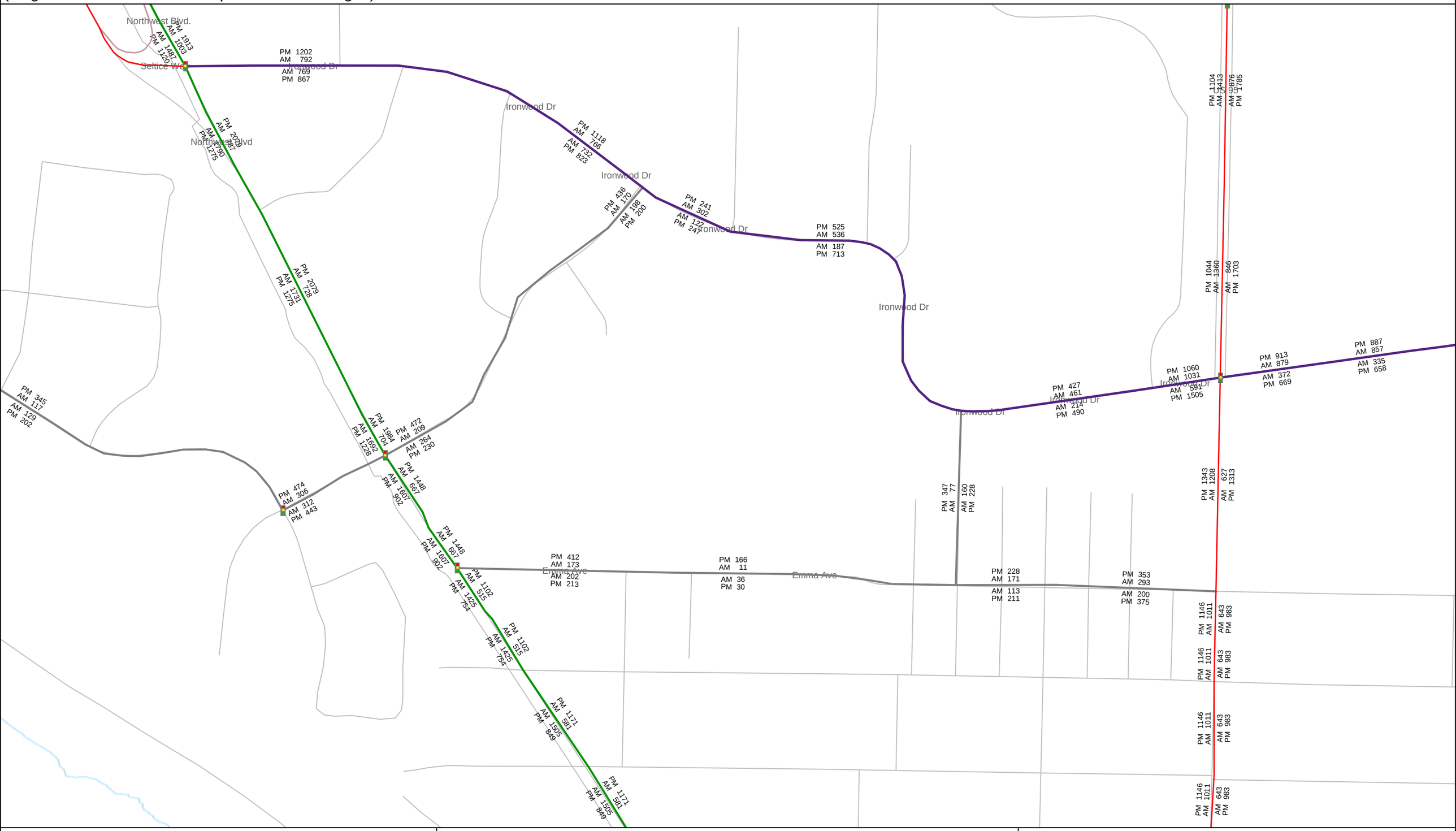
(Original Movement Restrict Option 2 with Changes)



US 95 - Walnut to Ironwood Dr	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL- Option B
Created on: 11.09.2013	2020BUILD_Scen_8_MoveRestrictOption2NewOptionB_9-11-13.ver	1:3508

KMPO 2020 BUILD - Scenario 5d Movement Restrictions Option B - US 95 - AM & PM PK HR Volumes & Signals

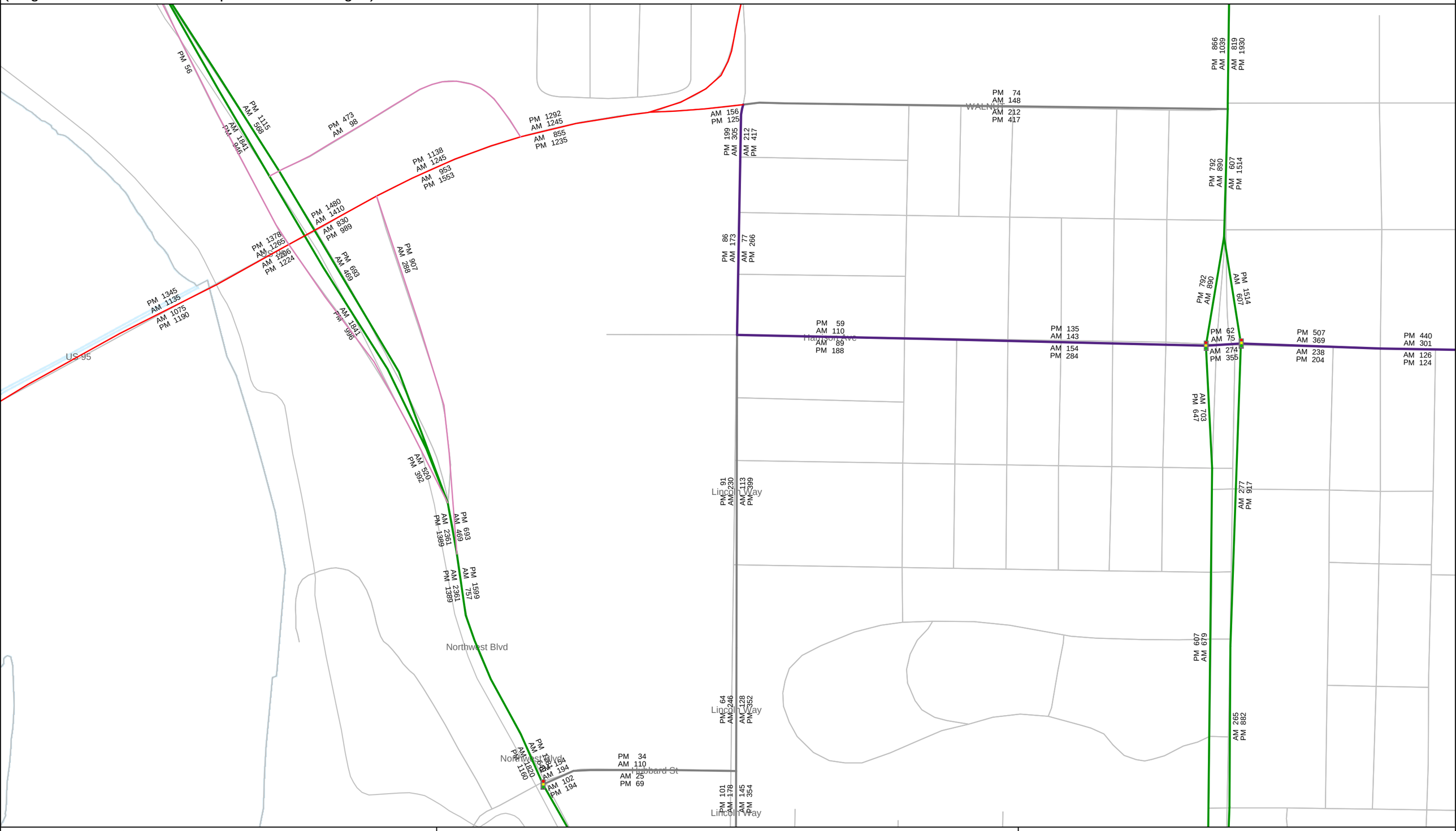
(Original Movement Restrict Option 2 with Changes)



US 95 - NW Blvd/Lakewood Area	AM & PM PK HR Volumes & Signals	KMPO 2020 BUILD MODEL- Option B
Created on: 11.09.2013	2020BUILD_Scen_8_MoveRestrictOption2NewOptionB_9-11-13.ver	1:3508

KMPO 2035 BUILD - Scenario 5d Movement Restrictions Option B - AM & PM PK HR Volumes & Signals

(Original Movement Restrict Option 2 with Changes)



US 95 - Hubbard to Walnut	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD - Option B
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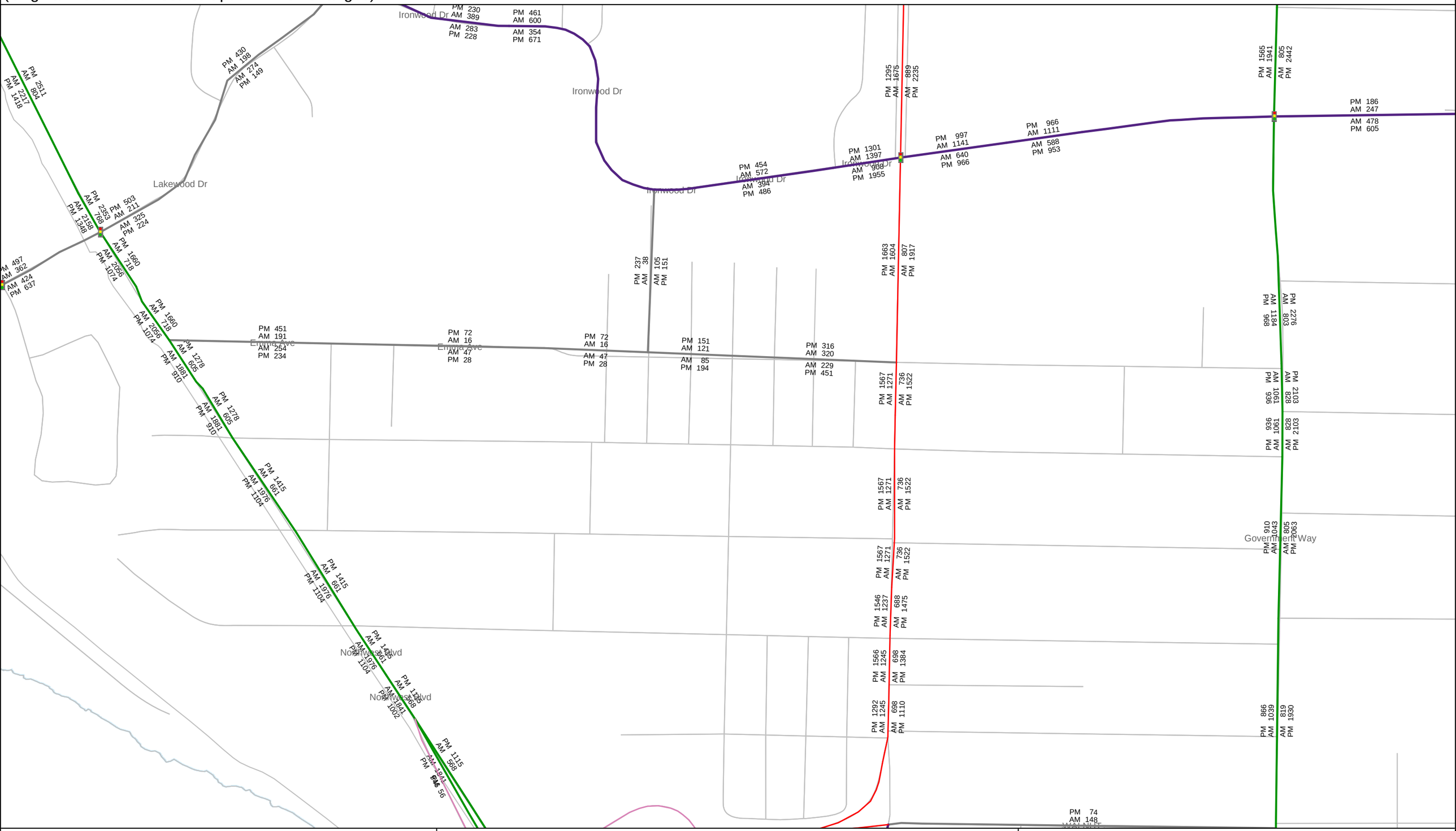
KMPO 2035 BUILD - Scenario 5d Movement Restrictions Option B - AM & PM PK HR Volumes & Signals

(Original Movement Restrict Option 2 with Changes)



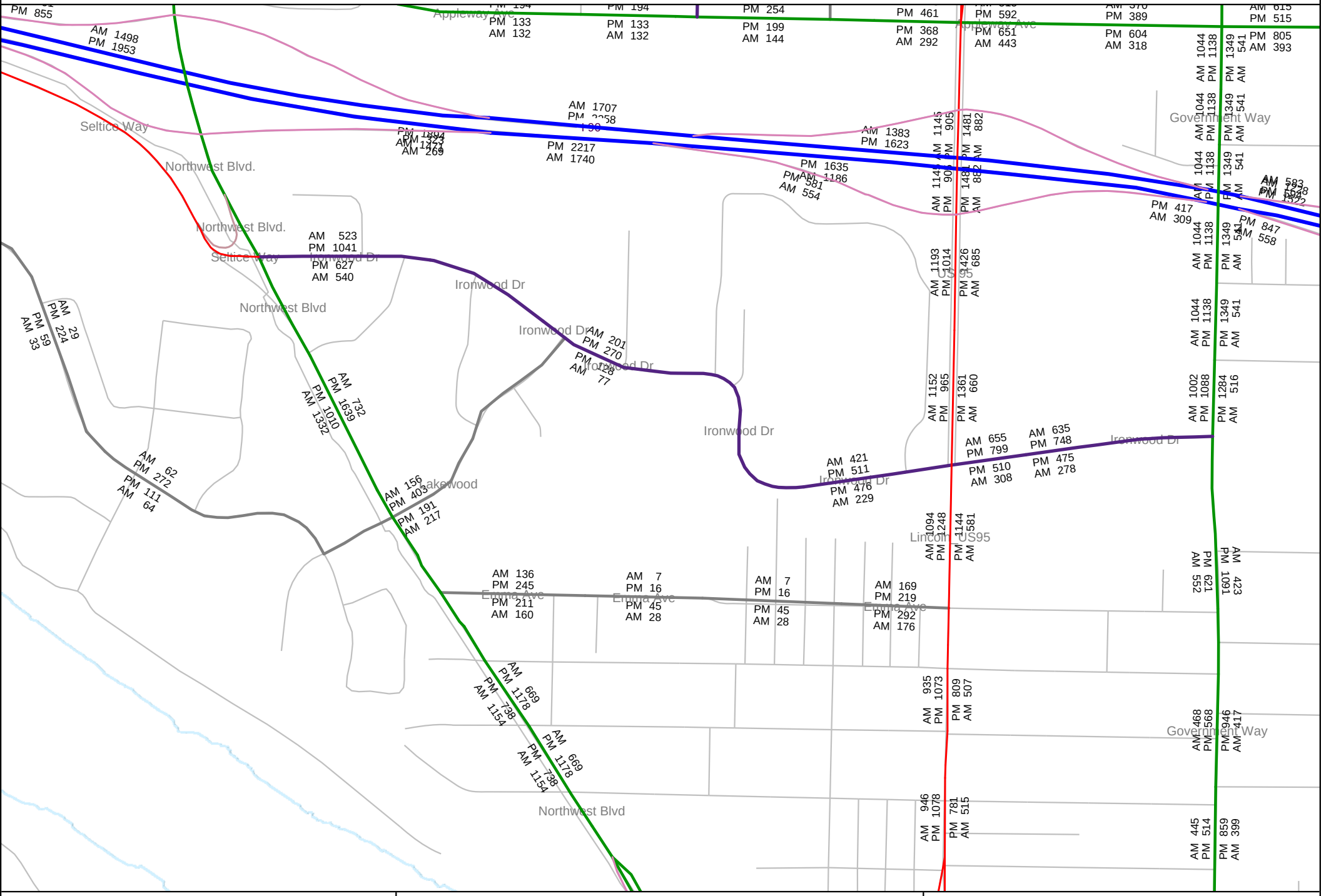
US 95 - Walnut to Ironwood Dr	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD - Option B
Created on: 11.09.2013	KMPO_2035_BUILD_Scen8_MoveRestrictOption2NewOptionB_9-11-13.ver	1:3661

KMPO 2035 BUILD - Scenario 5d Movement Restrictions Option B - AM & PM PK HR Volumes & Signals

(Original Movement Restrict Option 2 with Changes)

US 95 - NW Blvd/Lakewood Area	AM & PM PK HR Volumes & Signals	KMPO 2035 BUILD - Option B
Created on: 11.09.2013	KMPO_2035_BUILD_Scen8_MoveRestrictOption2NewOptionB_9-11-13.ver	1:3661

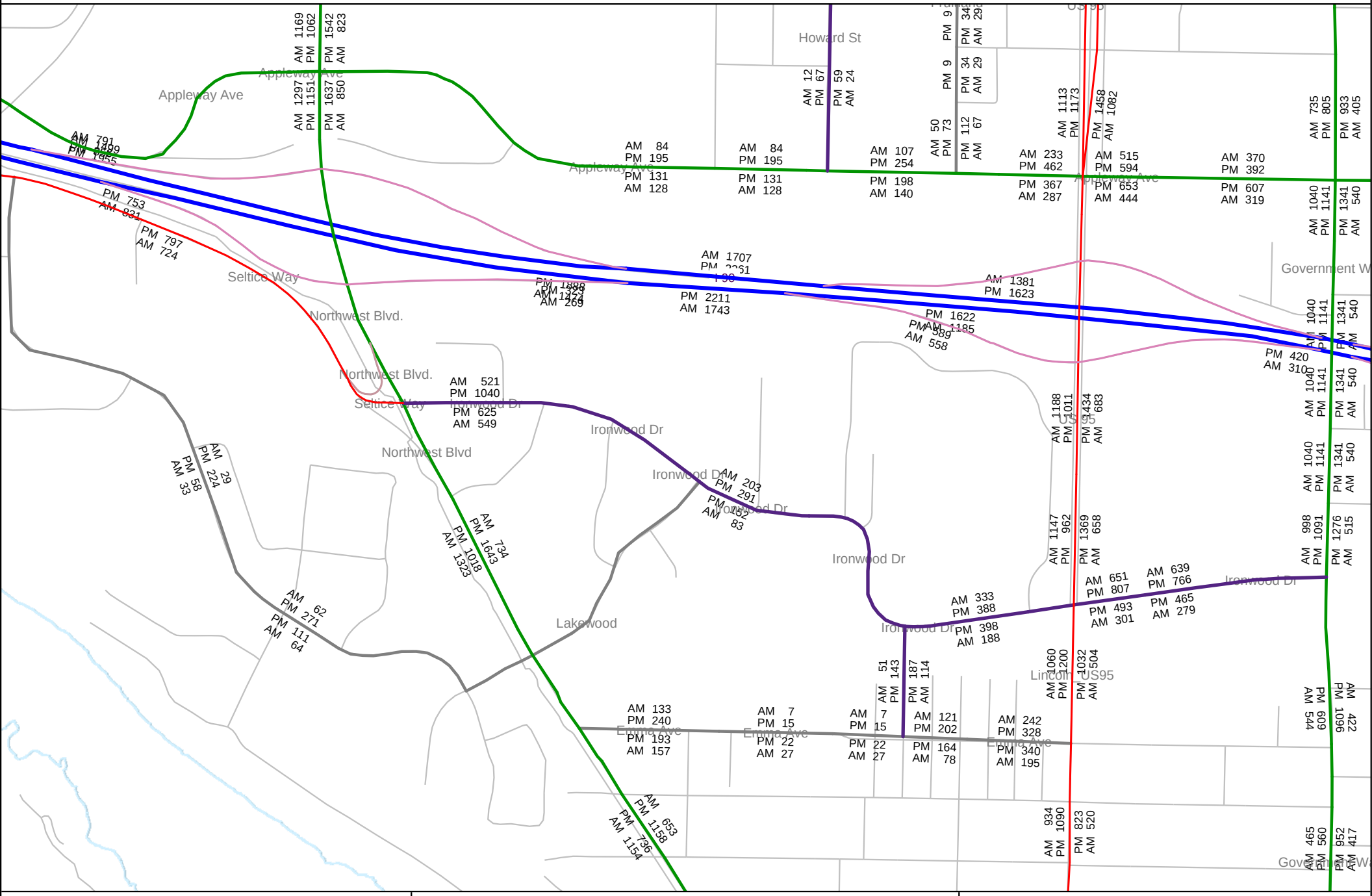
KMPO 2010 Base AM/PM PK HR Volumes



US 95 Area Ironwood/Emma	AM/PM PK HR Volumes	KMPO 2010 Base Model
Created on: 13.01.2014	KMPO_2010_FINAL_Base_11-18-13.ver	1:7346

KMPO 2010 Base with Medina Connection

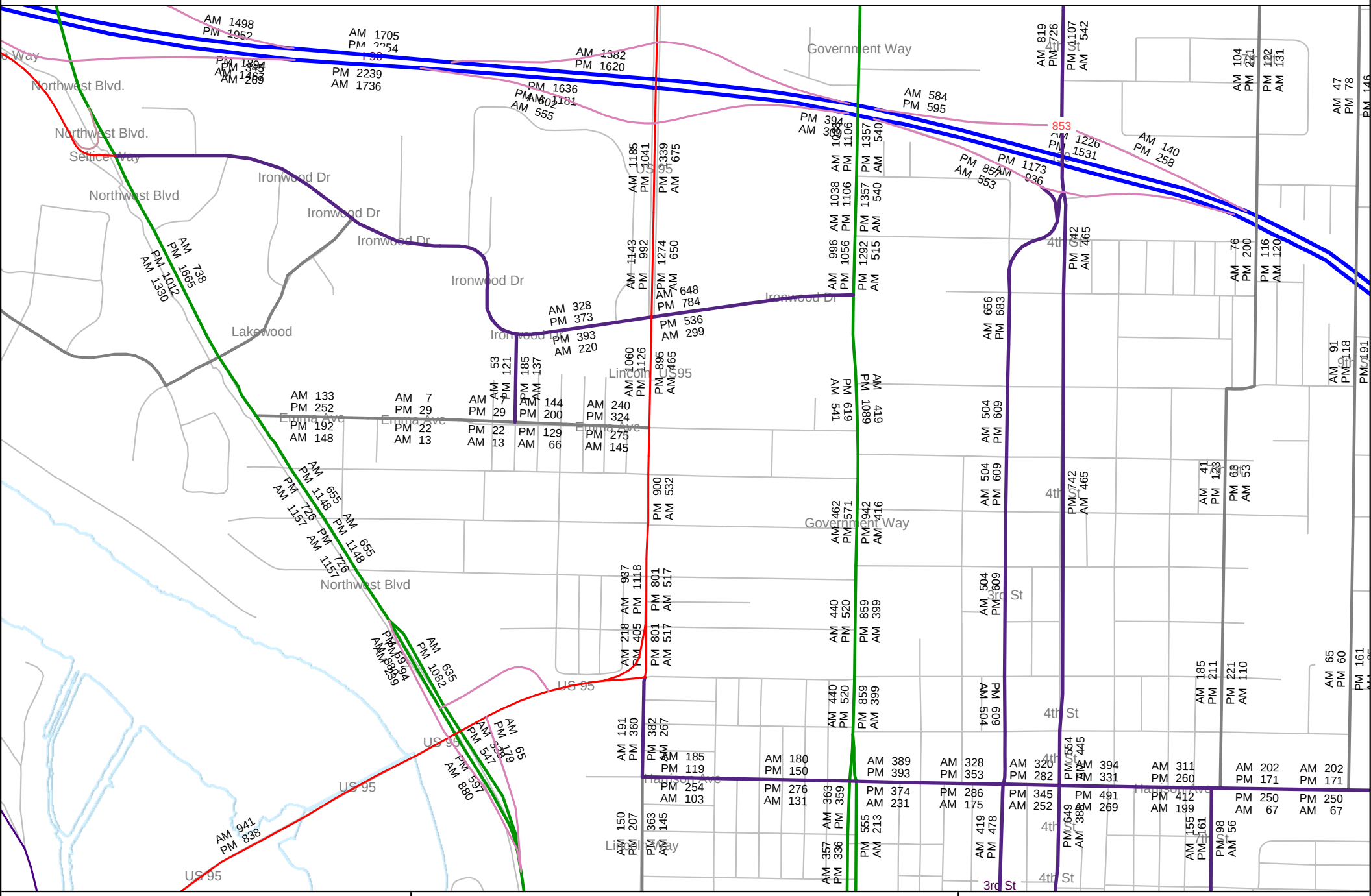
AM/PM PK HR Volumes



2010 KMPO Base with Medina	AM/PM PK HR Volumes	KMPO 2010 Base Model
Created on: 13.01.2014	KMPO_2010_FINAL_Base_1-13-14W_Medina.ver	1:7883

KMPO 2010 Base w/Medina Connection & Turn Restrictions

AM/PM PK HR Volumes



US 95 Area with Medina & Turn Restrictions	AM/PM PK HR Volumes	KMPO 2010 Base Model
Created on: 13.01.2014	KMPO_2010_FINAL_Base_1-13-14W_MedinaAndTurnRestrictions.ver	1:9854

Appendix B: SPOKANE RIVER CROSSING ANALYSIS

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/22/2013
Analysis Time Period: PM Peak
Intersection: US 95 / Blackwell Road
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2013
Project ID: US 95 Corridor Study
East/West Street: Blackwell Road
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		489	0	10	545	
Peak-Hour Factor, PHF		0.92	0.92	0.92	0.92	
Hourly Flow Rate, HFR		531	0	10	592	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	1	1	
Configuration			TR	L	T	
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	2	0	10			
Peak Hour Factor, PHF	0.92	0.92	0.92			
Hourly Flow Rate, HFR	2	0	10			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L		LTR				
v (vph)		10		12				
C(m) (vph)		1047		442				
v/c		0.01		0.03				
95% queue length		0.03		0.08				
Control Delay		8.5		13.4				
LOS		A		B				
Approach Delay				13.4				
Approach LOS				B				

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/22/2013
Analysis Time Period: PM Peak
Intersection: US 95 / Blackwell Road
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2013
Project ID: US 95 Corridor Study
East/West Street: Blackwell Road
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		489	0	10	545	
Peak-Hour Factor, PHF		0.92	0.92	0.92	0.92	
Peak-15 Minute Volume		133	0	3	148	
Hourly Flow Rate, HFR		531	0	10	592	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		1	0	1	1	
Configuration			TR	L	T	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	2	0	10			
Peak Hour Factor, PHF	0.92	0.92	0.92			
Peak-15 Minute Volume	1	0	3			
Hourly Flow Rate, HFR	2	0	10			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1	6.5	6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0	0	0	0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70	0.00	0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.1	6.4	6.5	6.2			
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	0	0	0			
t(f)		2.2	3.5	4.0	3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		531	1143	1143	531			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	531	
Potential Capacity	552	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	552	
Probability of Queue free St.	0.98	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	531	
Potential Capacity	1047	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1047	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1143	
Potential Capacity	202	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	200	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1143	
Potential Capacity	223	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.99
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.97
Movement Capacity	221	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1143	

Potential Capacity	202	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	200	

Result for 2 stage process:
a
y
C t 200
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage		
Conflicting Flows	1143	
Potential Capacity	223	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.99
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.97
Movement Capacity	221	

Results for Two-stage process:
a
y
C t 221

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	2	0	10			
Movement Capacity (vph)	221	200	552			
Shared Lane Capacity (vph)		442				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	221	200	552			
Volume	2	0	10			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						

n max	
C sh	442
SUM C sep	
n	
C act	

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L		LTR				
v (vph)		10		12				
C(m) (vph)		1047		442				
v/c		0.01		0.03				
95% queue length		0.03		0.08				
Control Delay		8.5		13.4				
LOS		A		B				
Approach Delay				13.4				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		8.5
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/22/2013
Analysis Time Period: AM
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2013
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	516			304	17
Peak-Hour Factor, PHF	0.89	0.89			0.89	0.89
Hourly Flow Rate, HFR	0	579			341	19
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	0	1			1	1
Configuration		LT			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				39	0	5
Peak Hour Factor, PHF				0.89	0.89	0.89
Hourly Flow Rate, HFR				43	0	5
Percent Heavy Vehicles				33	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	0						48	
C(m) (vph)	1210						296	
v/c	0.00						0.16	
95% queue length	0.00						0.57	
Control Delay	8.0						20.0	
LOS	A						C	
Approach Delay							20.0	
Approach LOS							C	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/22/2013
Analysis Time Period: AM
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2013
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	516			304	17
Peak-Hour Factor, PHF	0.89	0.89			0.89	0.89
Peak-15 Minute Volume	0	145			85	5
Hourly Flow Rate, HFR	0	579			341	19
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	0	1			1	1
Configuration	LT				T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				39	0	5
Peak Hour Factor, PHF				0.89	0.89	0.89
Peak-15 Minute Volume				11	0	1
Hourly Flow Rate, HFR				43	0	5
Percent Heavy Vehicles				33	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	579	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					33	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.7	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					33	0	0
t(f)	2.2					3.8	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	360					920	920	341
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		341
Potential Capacity		706
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		706
Probability of Queue free St.	1.00	0.99
Step 2: LT from Major St.	4	1
Conflicting Flows		360
Potential Capacity		1210
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1210
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		1.00
Step 3: TH from Minor St.	8	11
Conflicting Flows		920
Potential Capacity		273
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		273
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		920
Potential Capacity		265
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity		265

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		920

Potential Capacity		273
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		273

Result for 2 stage process:
a
y
C t 273

Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage

Conflicting Flows		920
Potential Capacity		265
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity		265

Results for Two-stage process:
a
y
C t 265

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				43	0	5
Movement Capacity (vph)				265	273	706
Shared Lane Capacity (vph)					283	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				265	273	706
Volume				43	0	5
Delay				21.2	18.2	10.1
Q sep				0.25	0.00	0.01
Q sep +1				1.25	1.00	1.01
round (Qsep +1)				1	1	1

n max	1
C sh	283
SUM C sep	296
n	1
C act	296

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	0						48	
C(m) (vph)	1210						296	
v/c	0.00						0.16	
95% queue length	0.00						0.57	
Control Delay	8.0						20.0	
LOS	A						C	
Approach Delay							20.0	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5	579	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	1.00	
d(M,LT), Delay for stream 1 or 4	8.0	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.0	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed:
Analysis Time Period: PM
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2013
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	4	495			517	33
Peak-Hour Factor, PHF	0.94	0.94			0.94	0.94
Hourly Flow Rate, HFR	4	526			550	35
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	0	1			1	1
Configuration		LT			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				22	0	4
Peak Hour Factor, PHF				0.94	0.94	0.94
Hourly Flow Rate, HFR				23	0	4
Percent Heavy Vehicles				33	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	4						27	
C(m) (vph)	1000						245	
v/c	0.00						0.11	
95% queue length	0.01						0.37	
Control Delay	8.6						22.5	
LOS	A						C	
Approach Delay							22.5	
Approach LOS							C	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed:
Analysis Time Period: PM
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2013
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	4	495			517	33
Peak-Hour Factor, PHF	0.94	0.94			0.94	0.94
Peak-15 Minute Volume	1	132			138	9
Hourly Flow Rate, HFR	4	526			550	35
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	0	1			1	1
Configuration	LT				T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				22	0	4
Peak Hour Factor, PHF				0.94	0.94	0.94
Peak-15 Minute Volume				6	0	1
Hourly Flow Rate, HFR				23	0	4
Percent Heavy Vehicles				33	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	526	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					33	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.7	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					33	0	0
t(f)	2.2					3.8	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	585					1084	1084	550
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		550
Potential Capacity		539
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		539
Probability of Queue free St.	1.00	0.99
Step 2: LT from Major St.	4	1
Conflicting Flows		585
Potential Capacity		1000
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1000
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		0.99
Step 3: TH from Minor St.	8	11
Conflicting Flows		1084
Potential Capacity		219
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		218
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		1084
Potential Capacity		210
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity		209

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1084

Potential Capacity		219
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		218

Result for 2 stage process:
a
y
C t 218

Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage

Conflicting Flows		1084
Potential Capacity		210
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity		209

Results for Two-stage process:
a
y
C t 209

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				23	0	4
Movement Capacity (vph)				209	218	539
Shared Lane Capacity (vph)					230	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				209	218	539
Volume				23	0	4
Delay				24.3	21.5	11.7
Q sep				0.16	0.00	0.01
Q sep +1				1.16	1.00	1.01
round (Qsep +1)				1	1	1

n max	1
C sh	230
SUM C sep	245
n	1
C act	245

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	4						27	
C(m) (vph)	1000						245	
v/c	0.00						0.11	
95% queue length	0.01						0.37	
Control Delay	8.6						22.5	
LOS	A						C	
Approach Delay							22.5	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5	526	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.99	
d(M,LT), Delay for stream 1 or 4	8.6	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.0	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/22/2013
Analysis Time Period: AM
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2013
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	407			303	23
Peak-Hour Factor, PHF	0.91	0.91			0.91	0.91
Hourly Flow Rate, HFR	0	447			332	25
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				109	0	1
Peak Hour Factor, PHF				0.91	0.91	0.91
Hourly Flow Rate, HFR				119	0	1
Percent Heavy Vehicles				3	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	0						120	
C(m) (vph)	1213						365	
v/c	0.00						0.33	
95% queue length	0.00						1.40	
Control Delay	8.0						19.6	
LOS	A						C	
Approach Delay							19.6	
Approach LOS							C	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/22/2013
Analysis Time Period: AM
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2013
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	407			303	23
Peak-Hour Factor, PHF	0.91	0.91			0.91	0.91
Peak-15 Minute Volume	0	112			83	6
Hourly Flow Rate, HFR	0	447			332	25
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				109	0	1
Peak Hour Factor, PHF				0.91	0.91	0.91
Peak-15 Minute Volume				30	0	0
Hourly Flow Rate, HFR				119	0	1
Percent Heavy Vehicles				3	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					3	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					3	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	357					779	779	332
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		332
Potential Capacity		714
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		714
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		357
Potential Capacity		1213
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1213
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		779
Potential Capacity		330
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		330
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		779
Potential Capacity		363
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		363

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		779

Potential Capacity		330
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		330

Result for 2 stage process:

a		
y		
C t		330
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage

Conflicting Flows		779
Potential Capacity		363
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		363

Results for Two-stage process:

a		
y		
C t		363

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				119	0	1
Movement Capacity (vph)				363	330	714
Shared Lane Capacity (vph)					364	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				363	330	714
Volume				119	0	1
Delay				19.7	15.9	10.0
Q sep				0.65	0.00	0.00
Q sep +1				1.65	1.00	1.00
round (Qsep +1)				2	1	1

n max	2
C sh	364
SUM C sep	366
n	1
C act	365

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	0						120	
C(m) (vph)	1213						365	
v/c	0.00						0.33	
95% queue length	0.00						1.40	
Control Delay	8.0						19.6	
LOS	A						C	
Approach Delay							19.6	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.0	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/22/2013
Analysis Time Period: PM
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2013
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	7	441			466	90
Peak-Hour Factor, PHF	0.96	0.96			0.96	0.96
Hourly Flow Rate, HFR	7	459			485	93
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				48	0	4
Peak Hour Factor, PHF				0.96	0.96	0.96
Hourly Flow Rate, HFR				50	0	4
Percent Heavy Vehicles				3	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	7						54	
C(m) (vph)	1006						305	
v/c	0.01						0.18	
95% queue length	0.02						0.63	
Control Delay	8.6						19.8	
LOS	A						C	
Approach Delay							19.8	
Approach LOS							C	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/22/2013
Analysis Time Period: PM
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2013
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	7	441			466	90
Peak-Hour Factor, PHF	0.96	0.96			0.96	0.96
Peak-15 Minute Volume	2	115			121	23
Hourly Flow Rate, HFR	7	459			485	93
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				48	0	4
Peak Hour Factor, PHF				0.96	0.96	0.96
Peak-15 Minute Volume				12	0	1
Hourly Flow Rate, HFR				50	0	4
Percent Heavy Vehicles				3	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					3	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					3	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	578					958	958	485
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		485
Potential Capacity		586
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		586
Probability of Queue free St.	1.00	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows		578
Potential Capacity		1006
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1006
Probability of Queue free St.	1.00	0.99
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		958
Potential Capacity		259
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		257
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		958
Potential Capacity		284
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		282

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		958

Potential Capacity		259
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		257

Result for 2 stage process:

a		
y		
C t		257
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage

Conflicting Flows		958
Potential Capacity		284
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		282

Results for Two-stage process:

a		
y		
C t		282

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				50	0	4
Movement Capacity (vph)				282	257	586
Shared Lane Capacity (vph)					293	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				282	257	586
Volume				50	0	4
Delay				20.5	19.0	11.2
Q sep				0.28	0.00	0.01
Q sep +1				1.28	1.00	1.01
round (Qsep +1)				1	1	1

n max	1
C sh	293
SUM C sep	305
n	1
C act	305

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	7						54	
C(m) (vph)	1006						305	
v/c	0.01						0.18	
95% queue length	0.02						0.63	
Control Delay	8.6						19.8	
LOS	A						C	
Approach Delay							19.8	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.6	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/8/2013
Analysis Time Period: PM
Intersection: US 95 / Blackwell Road
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2020
Project ID: US 95 Corridor Study
East/West Street: Blackwell Road
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		554	10	11	648	
Peak-Hour Factor, PHF		0.92	0.92	0.92	0.92	
Hourly Flow Rate, HFR		602	10	11	704	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	1	1	
Configuration			TR	L	T	
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	11	0	10			
Peak Hour Factor, PHF	0.92	0.92	0.92			
Hourly Flow Rate, HFR	11	0	10			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes /1			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L		LTR				
v (vph)		11		21				
C(m) (vph)		977		325				
v/c		0.01		0.06				
95% queue length		0.03		0.21				
Control Delay		8.7		20.4				
LOS		A		C				
Approach Delay				20.4				
Approach LOS				C				

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/8/2013
Analysis Time Period: PM
Intersection: US 95 / Blackwell Road
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2020
Project ID: US 95 Corridor Study
East/West Street: Blackwell Road
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		554	10	11	648	
Peak-Hour Factor, PHF		0.92	0.92	0.92	0.92	
Peak-15 Minute Volume		151	3	3	176	
Hourly Flow Rate, HFR		602	10	11	704	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		1	0	1	1	
Configuration			TR	L	T	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	11	0	10			
Peak Hour Factor, PHF	0.92	0.92	0.92			
Peak-15 Minute Volume	3	0	3			
Hourly Flow Rate, HFR	11	0	10			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes	/1		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1	6.5	6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0	0	0	0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70	0.00	0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.1	6.4	6.5	6.2			
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	0	0	0			
t(f)		2.2	3.5	4.0	3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		612	1333	1333	607			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	607	
Potential Capacity	500	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	500	
Probability of Queue free St.	0.98	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	612	
Potential Capacity	977	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	977	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1333	
Potential Capacity	155	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	153	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1333	
Potential Capacity	172	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.99
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.97
Movement Capacity	170	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1333	

Potential Capacity	155	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	153	

Result for 2 stage process:
a
y
C t 153
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage		
Conflicting Flows	1333	
Potential Capacity	172	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.99
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.97
Movement Capacity	170	

Results for Two-stage process:
a
y
C t 170

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	11	0	10			
Movement Capacity (vph)	170	153	500			
Shared Lane Capacity (vph)		248				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	170	153	500			
Volume	11	0	10			
Delay	27.6	28.5	12.3			
Q sep	0.08	0.00	0.03			
Q sep +1	1.08	1.00	1.03			
round (Qsep +1)	1	1	1			

n max	1
C sh	248
SUM C sep	325
n	1
C act	325

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L		LTR				
v (vph)		11		21				
C(m) (vph)		977		325				
v/c		0.01		0.06				
95% queue length		0.03		0.21				
Control Delay		8.7		20.4				
LOS		A		C				
Approach Delay				20.4				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		8.7
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/8/2013
Analysis Time Period: AM
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2020
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	614			358	25
Peak-Hour Factor, PHF	0.92	0.92			0.92	0.92
Hourly Flow Rate, HFR	0	667			389	27
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	0	1			1	1
Configuration		LT			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				36	0	12
Peak Hour Factor, PHF				0.92	0.92	0.92
Hourly Flow Rate, HFR				39	0	13
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	0						52	
C(m) (vph)	1154						336	
v/c	0.00						0.15	
95% queue length	0.00						0.54	
Control Delay	8.1						19.0	
LOS	A						C	
Approach Delay							19.0	
Approach LOS							C	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/8/2013
Analysis Time Period: AM
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2020
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	614			358	25
Peak-Hour Factor, PHF	0.92	0.92			0.92	0.92
Peak-15 Minute Volume	0	167			97	7
Hourly Flow Rate, HFR	0	667			389	27
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	0	1			1	1
Configuration	LT				T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				36	0	12
Peak Hour Factor, PHF				0.92	0.92	0.92
Peak-15 Minute Volume				10	0	3
Hourly Flow Rate, HFR				39	0	13
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	667	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					0	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	416					1056	1056	389
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		389
Potential Capacity		664
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		664
Probability of Queue free St.	1.00	0.98
Step 2: LT from Major St.	4	1
Conflicting Flows		416
Potential Capacity		1154
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1154
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		1.00
Step 3: TH from Minor St.	8	11
Conflicting Flows		1056
Potential Capacity		227
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		227
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		1056
Potential Capacity		252
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.98	1.00
Movement Capacity		252

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1056

Potential Capacity		227
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		227

Result for 2 stage process:

a		
y		
C t		227
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage

Conflicting Flows		1056
Potential Capacity		252
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.98	1.00
Movement Capacity		252

Results for Two-stage process:

a		
y		
C t		252

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				39	0	13
Movement Capacity (vph)				252	227	664
Shared Lane Capacity (vph)					298	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				252	227	664
Volume				39	0	13
Delay				21.9	20.9	10.5
Q sep				0.24	0.00	0.04
Q sep +1				1.24	1.00	1.04
round (Qsep +1)				1	1	1

n max	1
C sh	298
SUM C sep	336
n	1
C act	336

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	0						52	
C(m) (vph)	1154						336	
v/c	0.00						0.15	
95% queue length	0.00						0.54	
Control Delay	8.1						19.0	
LOS	A						C	
Approach Delay							19.0	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5	667	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	1.00	
d(M,LT), Delay for stream 1 or 4	8.1	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.0	

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/8/2013
Analysis Time Period: PM Peak Hour
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2020
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	22	542			652	48
Peak-Hour Factor, PHF	0.94	0.94			0.94	0.94
Hourly Flow Rate, HFR	23	576			693	51
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	0	1			1	1
Configuration		LT			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				39	0	0
Peak Hour Factor, PHF				0.94	0.94	0.94
Hourly Flow Rate, HFR				41	0	0
Percent Heavy Vehicles				0	0	33
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	23						41	
C(m) (vph)	873							
v/c	0.03							
95% queue length	0.08							
Control Delay	9.2						32.6	
LOS	A							
Approach Delay							32.6	
Approach LOS							D	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/8/2013
Analysis Time Period: PM Peak Hour
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2020
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	22	542			652	48
Peak-Hour Factor, PHF	0.94	0.94			0.94	0.94
Peak-15 Minute Volume	6	144			173	13
Hourly Flow Rate, HFR	23	576			693	51
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	0	1			1	1
Configuration	LT				T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				39	0	0
Peak Hour Factor, PHF				0.94	0.94	0.94
Peak-15 Minute Volume				10	0	0
Hourly Flow Rate, HFR				41	0	0
Percent Heavy Vehicles				0	0	33
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	576	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					0	0	33
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4	6.5	6.5
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	33
t(f)	2.2					3.5	4.0	3.6

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	744					1315	1315	693
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		693
Potential Capacity		395
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		395
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		744
Potential Capacity		873
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		873
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		0.96

Step 3: TH from Minor St.	8	11
Conflicting Flows		1315
Potential Capacity		159
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity		153
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1315
Potential Capacity		176
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.96	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		171

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1315

Potential Capacity		159
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity		153

Result for 2 stage process:
a
y
C t 153

Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage

Conflicting Flows		1315
Potential Capacity		176
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.96	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		171

Results for Two-stage process:
a
y
C t 171

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				41	0	0
Movement Capacity (vph)				171	153	395
Shared Lane Capacity (vph)					171	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				171	153	395
Volume				41	0	0
Delay				32.6	28.5	14.1
Q sep				0.37	0.00	0.00
Q sep +1				1.37	1.00	1.00
round (Qsep +1)				1	1	1

n max	1
C sh	171
SUM C sep	
n	1
C act	

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	23						41	
C(m) (vph)	873							
v/c	0.03							
95% queue length	0.08							
Control Delay	9.2						32.6	
LOS	A							
Approach Delay							32.6	
Approach LOS							D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(il), Volume for stream 2 or 5	576	
v(i2), Volume for stream 3 or 6	0	
s(il), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.96	
d(M,LT), Delay for stream 1 or 4	9.2	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.4	

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/30/2013
Analysis Time Period: AM Peak Hour
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2020
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	21	455			335	35
Peak-Hour Factor, PHF	0.95	0.95			0.95	0.95
Hourly Flow Rate, HFR	22	478			352	36
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				159	0	2
Peak Hour Factor, PHF				0.95	0.95	0.95
Hourly Flow Rate, HFR				167	0	2
Percent Heavy Vehicles				3	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	22						169	
C(m) (vph)	1182						316	
v/c	0.02						0.53	
95% queue length	0.06						2.97	
Control Delay	8.1						28.8	
LOS	A						D	
Approach Delay							28.8	
Approach LOS							D	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/30/2013
Analysis Time Period: AM Peak Hour
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2020
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	21	455			335	35
Peak-Hour Factor, PHF	0.95	0.95			0.95	0.95
Peak-15 Minute Volume	6	120			88	9
Hourly Flow Rate, HFR	22	478			352	36
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				159	0	2
Peak Hour Factor, PHF				0.95	0.95	0.95
Peak-15 Minute Volume				42	0	1
Hourly Flow Rate, HFR				167	0	2
Percent Heavy Vehicles				3	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					3	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					3	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	388					874	874	352
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		352
Potential Capacity		696
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		696
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		388
Potential Capacity		1182
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1182
Probability of Queue free St.	1.00	0.98
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		874
Potential Capacity		290
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		285
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		874
Potential Capacity		319
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.98	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		313

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		874

Potential Capacity		290
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		285

Result for 2 stage process:
a
y
C t 285

Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage

Conflicting Flows		874
Potential Capacity		319
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.98	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		313

Results for Two-stage process:
a
y
C t 313

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				167	0	2
Movement Capacity (vph)				313	285	696
Shared Lane Capacity (vph)					315	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				313	285	696
Volume				167	0	2
Delay				28.9	17.6	10.2
Q sep				1.34	0.00	0.01
Q sep +1				2.34	1.00	1.01
round (Qsep +1)				2	1	1

n max	2
C sh	315
SUM C sep	317
n	1
C act	316

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	22						169	
C(m) (vph)	1182						316	
v/c	0.02						0.53	
95% queue length	0.06						2.97	
Control Delay	8.1						28.8	
LOS	A						D	
Approach Delay							28.8	
Approach LOS							D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.1	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/8/2013
Analysis Time Period: PM
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2020
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	30	484			523	136
Peak-Hour Factor, PHF	0.96	0.96			0.96	0.96
Hourly Flow Rate, HFR	31	504			544	141
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				80	0	7
Peak Hour Factor, PHF				0.96	0.96	0.96
Hourly Flow Rate, HFR				83	0	7
Percent Heavy Vehicles				3	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	31						90	
C(m) (vph)	918						238	
v/c	0.03						0.38	
95% queue length	0.10						1.67	
Control Delay	9.1						29.0	
LOS	A						D	
Approach Delay							29.0	
Approach LOS							D	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/8/2013
Analysis Time Period: PM
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2020
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	30	484			523	136
Peak-Hour Factor, PHF	0.96	0.96			0.96	0.96
Peak-15 Minute Volume	8	126			136	35
Hourly Flow Rate, HFR	31	504			544	141
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				80	0	7
Peak Hour Factor, PHF				0.96	0.96	0.96
Peak-15 Minute Volume				21	0	2
Hourly Flow Rate, HFR				83	0	7
Percent Heavy Vehicles				3	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					3	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					3	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	685					1110	1110	544
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		544
Potential Capacity		543
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		543
Probability of Queue free St.	1.00	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows		685
Potential Capacity		918
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		918
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		1110
Potential Capacity		211
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		204
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1110
Potential Capacity		231
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.96	0.97
Movement Capacity		223

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1110

Potential Capacity		211
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		204

Result for 2 stage process:

a		
y		
C t		204
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage

Conflicting Flows		1110
Potential Capacity		231
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.96	0.97
Movement Capacity		223

Results for Two-stage process:

a		
y		
C t		223

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				83	0	7
Movement Capacity (vph)				223	204	543
Shared Lane Capacity (vph)					234	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				223	204	543
Volume				83	0	7
Delay				30.4	22.6	11.7
Q sep				0.70	0.00	0.02
Q sep +1				1.70	1.00	1.02
round (Qsep +1)				2	1	1

n max	2
C sh	234
SUM C sep	242
n	1
C act	238

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	31						90	
C(m) (vph)	918						238	
v/c	0.03						0.38	
95% queue length	0.10						1.67	
Control Delay	9.1						29.0	
LOS	A						D	
Approach Delay							29.0	
Approach LOS							D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.1	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/30/2013
Analysis Time Period: PM
Intersection: US 95 / Blackwell Road
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: Blackwell Road
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		605	44	12	627	
Peak-Hour Factor, PHF		0.92	0.92	0.92	0.92	
Hourly Flow Rate, HFR		657	47	13	681	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	1	1	
Configuration			TR	L	T	
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	62	0	8			
Peak Hour Factor, PHF	0.92	0.92	0.92			
Hourly Flow Rate, HFR	67	0	8			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes	/1		/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L		LTR				
v (vph)		13		75				
C(m) (vph)		903		172				
v/c		0.01		0.44				
95% queue length		0.04		1.99				
Control Delay		9.0		41.2				
LOS		A		E				
Approach Delay				41.2				
Approach LOS				E				

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 7/30/2013
Analysis Time Period: PM
Intersection: US 95 / Blackwell Road
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: Blackwell Road
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		605	44	12	627	
Peak-Hour Factor, PHF		0.92	0.92	0.92	0.92	
Peak-15 Minute Volume		164	12	3	170	
Hourly Flow Rate, HFR		657	47	13	681	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		1	0	1	1	
Configuration			TR	L	T	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	62	0	8			
Peak Hour Factor, PHF	0.92	0.92	0.92			
Peak-15 Minute Volume	17	0	2			
Hourly Flow Rate, HFR	67	0	8			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes	/1		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1	6.5	6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0	0	0	0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70	0.00	0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.1	6.4	6.5	6.2			
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	0	0	0			
t(f)		2.2	3.5	4.0	3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		704	1387	1387	680			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	680	
Potential Capacity	454	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	454	
Probability of Queue free St.	0.98	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	704	
Potential Capacity	903	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	903	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1387	
Potential Capacity	144	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	142	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1387	
Potential Capacity	159	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.99
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.97
Movement Capacity	157	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1387	

Potential Capacity	144	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	142	

Result for 2 stage process:
a
y
C t 142
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage		
Conflicting Flows	1387	
Potential Capacity	159	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.99
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.97
Movement Capacity	157	

Results for Two-stage process:
a
y
C t 157

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	67	0	8			
Movement Capacity (vph)	157	142	454			
Shared Lane Capacity (vph)		169				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	157	142	454			
Volume	67	0	8			
Delay	44.0	30.4	13.1			
Q sep	0.82	0.00	0.03			
Q sep +1	1.82	1.00	1.03			
round (Qsep +1)	2	1	1			

n max	2
C sh	169
SUM C sep	176
n	1
C act	172

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L		LTR				
v (vph)		13		75				
C(m) (vph)		903		172				
v/c		0.01		0.44				
95% queue length		0.04		1.99				
Control Delay		9.0		41.2				
LOS		A		E				
Approach Delay				41.2				
Approach LOS				E				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		9.0
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/7/2013
Analysis Time Period: AM Peak Hour
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	10	593			369	19
Peak-Hour Factor, PHF	0.92	0.92			0.92	0.92
Hourly Flow Rate, HFR	10	644			401	20
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	0	1			1	1
Configuration		LT			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				138	0	1
Peak Hour Factor, PHF				0.92	0.92	0.92
Hourly Flow Rate, HFR				149	0	1
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	10						150	
C(m) (vph)	1149						248	
v/c	0.01						0.60	
95% queue length	0.03						3.56	
Control Delay	8.2						39.5	
LOS	A						E	
Approach Delay							39.5	
Approach LOS							E	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/7/2013
Analysis Time Period: AM Peak Hour
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	10	593			369	19
Peak-Hour Factor, PHF	0.92	0.92			0.92	0.92
Peak-15 Minute Volume	3	161			100	5
Hourly Flow Rate, HFR	10	644			401	20
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	0	1			1	1
Configuration	LT				T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				138	0	1
Peak Hour Factor, PHF				0.92	0.92	0.92
Peak-15 Minute Volume				38	0	0
Hourly Flow Rate, HFR				149	0	1
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	644	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					0	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	421					1065	1065	401
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		401
Potential Capacity		653
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		653
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		421
Potential Capacity		1149
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1149
Probability of Queue free St.	1.00	0.99
Maj L-Shared Prob Q free St.		0.99

Step 3: TH from Minor St.	8	11
Conflicting Flows		1065
Potential Capacity		224
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		221
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1065
Potential Capacity		249
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		247

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1065

Potential Capacity		224
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		221

Result for 2 stage process:

a		
y		
C t		221
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage

Conflicting Flows		1065
Potential Capacity		249
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		247

Results for Two-stage process:

a		
y		
C t		247

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				149	0	1
Movement Capacity (vph)				247	221	653
Shared Lane Capacity (vph)					248	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				247	221	653
Volume				149	0	1
Delay				39.5	21.3	10.5
Q sep				1.64	0.00	0.00
Q sep +1				2.64	1.00	1.00
round (Qsep +1)				3	1	1

n max	3
C sh	248
SUM C sep	249
n	1
C act	248

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	10						150	
C(m) (vph)	1149						248	
v/c	0.01						0.60	
95% queue length	0.03						3.56	
Control Delay	8.2						39.5	
LOS	A						E	
Approach Delay							39.5	
Approach LOS							E	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(i1), Volume for stream 2 or 5	644	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.99	
d(M,LT), Delay for stream 1 or 4	8.2	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.1	

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/8/2013
Analysis Time Period: PM Peak Hour
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	85	528			624	294
Peak-Hour Factor, PHF	0.94	0.94			0.94	0.94
Hourly Flow Rate, HFR	90	561			663	312
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	0	1			1	1
Configuration		LT			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				61	0	15
Peak Hour Factor, PHF				0.94	0.94	0.94
Hourly Flow Rate, HFR				64	0	15
Percent Heavy Vehicles				0	0	33
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	90						79	
C(m) (vph)	716						162	
v/c	0.13						0.49	
95% queue length	0.43						2.33	
Control Delay	10.7						46.7	
LOS	B						E	
Approach Delay							46.7	
Approach LOS							E	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/8/2013
Analysis Time Period: PM Peak Hour
Intersection: US 95 / Fairmont Loop
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: S Fairmont Loop
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	85	528			624	294
Peak-Hour Factor, PHF	0.94	0.94			0.94	0.94
Peak-15 Minute Volume	23	140			166	78
Hourly Flow Rate, HFR	90	561			663	312
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	0	1			1	1
Configuration	LT				T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				61	0	15
Peak Hour Factor, PHF				0.94	0.94	0.94
Peak-15 Minute Volume				16	0	4
Hourly Flow Rate, HFR				64	0	15
Percent Heavy Vehicles				0	0	33
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	561	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					0	0	33
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4	6.5	6.5
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	33
t(f)	2.2					3.5	4.0	3.6

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	975					1404	1404	663
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		663
Potential Capacity		411
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		411
Probability of Queue free St.	1.00	0.96
Step 2: LT from Major St.	4	1
Conflicting Flows		975
Potential Capacity		716
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		716
Probability of Queue free St.	1.00	0.87
Maj L-Shared Prob Q free St.		0.81
Step 3: TH from Minor St.	8	11
Conflicting Flows		1404
Potential Capacity		141
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.81	0.81
Movement Capacity		115
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		1404
Potential Capacity		155
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.81	
Maj. L, Min T Adj. Imp Factor.	0.86	
Cap. Adj. factor due to Impeding mvmnt	0.82	0.87
Movement Capacity		136

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1404

Potential Capacity		141
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.81	0.81
Movement Capacity		115

Result for 2 stage process:
a
y
C t 115
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage		
Conflicting Flows		1404
Potential Capacity		155
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.81	
Maj. L, Min T Adj. Imp Factor.	0.86	
Cap. Adj. factor due to Impeding mvmnt	0.82	0.87
Movement Capacity		136

Results for Two-stage process:
a
y
C t 136

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				64	0	15
Movement Capacity (vph)				136	115	411
Shared Lane Capacity (vph)					156	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				136	115	411
Volume				64	0	15
Delay				53.0	36.3	14.1
Q sep				0.94	0.00	0.06
Q sep +1				1.94	1.00	1.06
round (Qsep +1)				2	1	1

n max	2
C sh	156
SUM C sep	168
n	1
C act	162

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	90						79	
C(m) (vph)	716						162	
v/c	0.13						0.49	
95% queue length	0.43						2.33	
Control Delay	10.7						46.7	
LOS	B						E	
Approach Delay							46.7	
Approach LOS							E	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.87	1.00
v(i1), Volume for stream 2 or 5	561	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.81	
d(M,LT), Delay for stream 1 or 4	10.7	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	2.0	

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/7/2013
Analysis Time Period: AM Peak Hour
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	90	506			343	26
Peak-Hour Factor, PHF	0.92	0.92			0.92	0.92
Hourly Flow Rate, HFR	97	549			372	28
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				97	0	91
Peak Hour Factor, PHF				0.92	0.92	0.92
Hourly Flow Rate, HFR				105	0	98
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	97						203	
C(m) (vph)	1170						365	
v/c	0.08						0.56	
95% queue length	0.27						3.24	
Control Delay	8.4						26.5	
LOS	A						D	
Approach Delay							26.5	
Approach LOS							D	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed: 8/7/2013
Analysis Time Period: AM Peak Hour
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	90	506			343	26
Peak-Hour Factor, PHF	0.92	0.92			0.92	0.92
Peak-15 Minute Volume	24	138			93	7
Hourly Flow Rate, HFR	97	549			372	28
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				97	0	91
Peak Hour Factor, PHF				0.92	0.92	0.92
Peak-15 Minute Volume				26	0	25
Hourly Flow Rate, HFR				105	0	98
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					0	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	400					1115	1115	372
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		372
Potential Capacity		678
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		678
Probability of Queue free St.	1.00	0.86
Step 2: LT from Major St.	4	1
Conflicting Flows		400
Potential Capacity		1170
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1170
Probability of Queue free St.	1.00	0.92
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		1115
Potential Capacity		210
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.92
Movement Capacity		193
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		1115
Potential Capacity		232
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.92	
Maj. L, Min T Adj. Imp Factor.	0.94	
Cap. Adj. factor due to Impeding mvmnt	0.80	0.92
Movement Capacity		213

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1115

Potential Capacity		210
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.92
Movement Capacity		193

Result for 2 stage process:
a
y
C t 193

Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage

Conflicting Flows		1115
Potential Capacity		232
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.92	
Maj. L, Min T Adj. Imp Factor.	0.94	
Cap. Adj. factor due to Impeding mvmnt	0.80	0.92
Movement Capacity		213

Results for Two-stage process:
a
y
C t 213

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				105	0	98
Movement Capacity (vph)				213	193	678
Shared Lane Capacity (vph)					318	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				213	193	678
Volume				105	0	98
Delay				37.3	23.7	11.2
Q sep				1.09	0.00	0.31
Q sep +1				2.09	1.00	1.31
round (Qsep +1)				2	1	1

n max	2
C sh	318
SUM C sep	412
n	1
C act	365

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	97						203	
C(m) (vph)	1170						365	
v/c	0.08						0.56	
95% queue length	0.27						3.24	
Control Delay	8.4						26.5	
LOS	A						D	
Approach Delay							26.5	
Approach LOS							D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.92	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.4	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed:
Analysis Time Period: PM
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	73	557			597	92
Peak-Hour Factor, PHF	0.96	0.96			0.96	0.96
Hourly Flow Rate, HFR	76	580			621	95
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				92	0	108
Peak Hour Factor, PHF				0.96	0.96	0.96
Hourly Flow Rate, HFR				95	0	112
Percent Heavy Vehicles				3	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		Yes	/1
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	76						207	
C(m) (vph)	894						269	
v/c	0.09						0.77	
95% queue length	0.28						5.75	
Control Delay	9.4						52.1	
LOS	A						F	
Approach Delay							52.1	
Approach LOS							F	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc.
Date Performed:
Analysis Time Period: PM
Intersection: US 95 / Upriver Drive
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: W Upriver Dr
North/South Street: US 95
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	73	557			597	92
Peak-Hour Factor, PHF	0.96	0.96			0.96	0.96
Peak-15 Minute Volume	19	145			155	24
Hourly Flow Rate, HFR	76	580			621	95
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				92	0	108
Peak Hour Factor, PHF				0.96	0.96	0.96
Peak-15 Minute Volume				24	0	28
Hourly Flow Rate, HFR				95	0	112
Percent Heavy Vehicles				3	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		Yes /1
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					3	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					3	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	716					1353	1353	621
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		621
Potential Capacity		491
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		491
Probability of Queue free St.	1.00	0.77

Step 2: LT from Major St.	4	1
Conflicting Flows		716
Potential Capacity		894
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		894
Probability of Queue free St.	1.00	0.91
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		1353
Potential Capacity		151
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.91	0.91
Movement Capacity		138
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1353
Potential Capacity		164
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.91	
Maj. L, Min T Adj. Imp Factor.	0.93	
Cap. Adj. factor due to Impeding mvmnt	0.72	0.91
Movement Capacity		150

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1353

Potential Capacity		151
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.91	0.91
Movement Capacity		138

Result for 2 stage process:
a
y
C t 138

Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage

Conflicting Flows		1353
Potential Capacity		164
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.91	
Maj. L, Min T Adj. Imp Factor.	0.93	
Cap. Adj. factor due to Impeding mvmnt	0.72	0.91
Movement Capacity		150

Results for Two-stage process:
a
y
C t 150

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				95	0	112
Movement Capacity (vph)				150	138	491
Shared Lane Capacity (vph)					240	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				150	138	491
Volume				95	0	112
Delay				63.3	31.1	14.5
Q sep				1.67	0.00	0.45
Q sep +1				2.67	1.00	1.45
round (Qsep +1)				3	1	1

n max	3
C sh	240
SUM C sep	327
n	1
C act	269

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L						LTR	
v (vph)	76						207	
C(m) (vph)	894						269	
v/c	0.09						0.77	
95% queue length	0.28						5.75	
Control Delay	9.4						52.1	
LOS	A						F	
Approach Delay							52.1	
Approach LOS							F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.91	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.4	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

Appendix C: IRONWOOD SEGMENT ANALYSIS

Step 1. Determine and label movement priorities

Rank 1	EBR
	EBT
	EBL
	SBR
Rank 3	NBR
	WBR
Rank 4	NBT
	SBT
	WBT
	NBL
	SBL
	WBL

Step 2. Convert volumes to peak 15-min flow rates

		Peak 15 min vph		Approach volumes and distributions		PHF
Rank 1	EBR	16		EB Volume 2010	306	0.87
	EBT	65		*EBL Proportion*	*0.77*	
	EBL	271		*EBT Proportion*	*0.18*	
	SBR	949		*EBR Proportion*	*0.04*	
Rank 3	NBR	19		WB Volume 2010	64	
	WBR	19		*WBL Proportion*	*0.03*	
Rank 4	NBT	274		*WBT Proportion*	*0.71*	
	SBT	134		*WBR Proportion*	*0.25*	
	WBT	52		NB Volume 2010	344	
	NBL	102		*NBL Proportion*	*0.26*	
	SBL	19		*NBT Proportion*	*0.69*	
	WBL	2		*NBR Proportion*	*0.05*	
				SBT/L Volume 2010	133	
				SBL Proportion	*0.12*	
				SBT Proportion	*0.88*	
				SBR Volume 2010	826	

Step 3. Compute the conflicting flow rates

NOTE: The following equations are modified from the HCM to account for the unusual configuration of the US 95/Walnut Ave/Lincoln Way intersection.

	Movement	Conflicting Movements	Conflicting Flow Rate
Rank 3	NBR	EBT, 2 EBL, 1/2 EBR, 1/2 SBL	625
	WBR	2 EBL, 1/2 EBT, 1/2 NBT	712
Rank 4	NBT	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL	642
	SBT	EBT, 2 EBL, EBR, 1/2 WBT, 1/2 WBL, 1/2 NBL	701
	WBT	EBT, 2 EBL, 1/2 EBR, 1/2 NBL, 1/2 NBT, 1/2 SBT, 1/2 SBL	879
	NBL	EBT, 2 EBL, 1/2 EBR, 1/2 SBT, 1/2 WBT, 1/2 WBL	709
	SBL	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL, 1/2 NBT	780
	WBL	EBT, 2 EBL, EBR, 1/2 NBL, 1/2 NBT, 1/2 SBL, 1/2 SBT	887

Step 4. Determine critical headways and follow-up headways

		t_c,base	P_HV	t_c	t_f,base	t_f		
							t_c,HV	1
Rank 3	NBR	6.2	0%	6.2	3.3	3.3	*no grade*	
	WBR	6.2	0%	6.2	3.3	3.3	*not a 3-leg intx*	
Rank 4	NBT	5.5	2%	5.5	4.0	4.0		
	SBT	5.5	2%	5.5	4.0	4.0	t_f,HV	0.9
	WBT	5.5	0%	5.5	4.0	4.0		
	NBL	6.1	0%	6.1	3.5	3.5		
	SBL	6.1	0%	6.1	3.5	3.5		
	WBL	6.1	0%	6.1	3.5	3.5		

Step 5. Compute potential capacities

No upstream signal present. The closest signal is approx. 0.5 mile.

		c_p,x
Rank 3	NBR	489
	WBR	436
Rank 4	NBT	469
	SBT	441
	WBT	368
	NBL	428
	SBL	392
	WBL	341

Step 6. Compute Rank 1 movement capacity

Not needed for analysis

Step 7. Compute Rank 2 movement capacity

No Rank 2 movements

Step 8. Compute Rank 3 movement capacity

		c_m,k		
Rank 3	NBR	489	f_k	1
	WBR	436		

Step 9. Compute Rank 4 movement capacity

Note: There are no higher rank queuing probabilities to account for in this intersection configuration.

		c_m,l
Rank 4	NBT	469
	SBT	441
	WBT	368
	NBL	428
	SBL	392
	WBL	341

Step 10. Final capacity adjustments

	c_SH
NBT/R	470
WBL/T/R	382
SBT/L	434

Step 11. Compute movement control delay

	v_x	c_m,x	d	LOS	v/c
NBT/R	293.8509	470	25	C	0.63
WBL/T/R	73.56322	382	17	C	0.19
SBT/L	152.8736	434	18	C	0.35
NBL	101.5514	428	16	C	0.24

Step 12. Compute approach and intersection control delay

	d_A	v_A	
EB	5	351.7241	
WB	17	73.56322	
NB	22	395.4023	
SB	2	1102.299	Includes the SBR, which is a free right. Assumption: no delay on SBR.
d_I	7		

Step 13. Compute 95th percentile queue lengths

	Q_95 (veh)
NBT/R	4
WBL/T/R	1
SBT/L	2
NBL	1

Step 1. Determine and label movement priorities

Rank 1	EBR
	EBT
	EBL
	SBR
Rank 3	NBR
	WBR
Rank 4	NBT
	SBT
	WBT
	NBL
	SBL
	WBL

Step 2. Convert volumes to peak 15-min flow rates

		Peak 15 min	vph
Rank 1	EBR		28
	EBT		115
	EBL		323
	SBR		770
Rank 3	NBR		23
	WBR		27
Rank 4	NBT		432
	SBT		61
	WBT		88
	NBL		115
	SBL		9
	WBL		0

Approach volumes and distributions		PHF
EB Volume 2010	452	0.97
EBL Proportion	*0.69*	
EBT Proportion	*0.25*	
EBR Proportion	*0.06*	
WB Volume 2010	111	
WBL Proportion	*0.00*	
WBT Proportion	*0.76*	
WBR Proportion	*0.24*	
NB Volume 2010	553	
NBL Proportion	*0.20*	
NBT Proportion	*0.76*	
NBR Proportion	*0.04*	
SBT/L Volume 2010	254	
SBL Proportion	*0.03*	
SBT Proportion	*0.23*	
SBR Volume 2010	747	

Step 3. Compute the conflicting flow rates

NOTE: The following equations are modified from the HCM to account for the unusual configuration of the US 95/Walnut Ave/Lincoln Way intersection.

	Movement	Conflicting Movements	Conflicting Flow Rate
Rank 3	NBR	EBT, 2 EBL, 1/2 EBR, 1/2 SBL	780
	WBR	2 EBL, 1/2 EBT, 1/2 NBT	920
Rank 4	NBT	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL	819
	SBT	EBT, 2 EBL, EBR, 1/2 WBT, 1/2 WBL, 1/2 NBL	890
	WBT	EBT, 2 EBL, 1/2 EBR, 1/2 NBL, 1/2 NBT, 1/2 SBT, 1/2 SBL	1083
	NBL	EBT, 2 EBL, 1/2 EBR, 1/2 SBT, 1/2 WBT, 1/2 WBL	849
	SBL	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL, 1/2 NBT	1035
	WBL	EBT, 2 EBL, EBR, 1/2 NBL, 1/2 NBT, 1/2 SBL, 1/2 SBT	1097

Step 4. Determine critical headways and follow-up headways

		t_c,base	P_HV	t_c	t_f,base	t_f		
							t_c,HV	1
Rank 3	NBR	6.2	0%	6.2	3.3	3.3	*no grade*	
	WBR	6.2	0%	6.2	3.3	3.3	*not a 3-leg intx*	
Rank 4	NBT	5.5	2%	5.5	4.0	4.0		
	SBT	5.5	2%	5.5	4.0	4.0	t_f,HV	0.9
	WBT	5.5	0%	5.5	4.0	4.0		
	NBL	6.1	0%	6.1	3.5	3.5		
	SBL	6.1	0%	6.1	3.5	3.5		
	WBL	6.1	0%	6.1	3.5	3.5		

Step 5. Compute potential capacities

No upstream signal present. The closest signal is approx. 0.5 mile.

		c_p,x
Rank 3	NBR	399
	WBR	331
Rank 4	NBT	389
	SBT	361
	WBT	296
	NBL	358
	SBL	282
	WBL	261

Step 6. Compute Rank 1 movement capacity

Not needed for analysis

Step 7. Compute Rank 2 movement capacity

No Rank 2 movements

Step 8. Compute Rank 3 movement capacity

		c_m,k		
Rank 3	NBR	399	f_k	1
	WBR	331		

Step 9. Compute Rank 4 movement capacity

Note: There are no higher rank queuing probabilities to account for in this intersection configuration.

		c_m,l
Rank 4	NBT	389
	SBT	361
	WBT	296
	NBL	358
	SBL	282
	WBL	261

Step 10. Final capacity adjustments

	c_SH
NBT/R	390
WBL/T/R	303
SBT/L	349

Step 11. Compute movement control delay

	v_x	c_m,x	d	LOS	v/c
NBT/R	455.3172	390	131	F	1.17
WBL/T/R	114.433	303	24	C	0.38
SBT/L	69.21606	349	18	C	0.20
NBL	114.7859	358	20	C	0.32

Step 12. Compute approach and intersection control delay

	d_A	v_A	
EB	5	465.9794	
WB	24	114.433	
NB	109	570.1031	
SB	1	839.3192	Includes the SBR, which is a free right. Assumption: no delay on SBR.
d_I	34		

Step 13. Compute 95th percentile queue lengths

	Q_95 (veh)
NBT/R	18
WBL/T/R	2
SBT/L	1
NBL	1

Step 1. Determine and label movement priorities

Rank 1	EBR
	EBT
	EBL
	SBR
Rank 3	NBR
	WBR
Rank 4	NBT
	SBT
	WBT
	NBL
	SBL
	WBL

Step 2. Convert volumes to peak 15-min flow rates

		Peak 15 min	vph
Rank 1	EBR		23
	EBT		94
	EBL		393
	SBR		912
Rank 3	NBR		22
	WBR		35
Rank 4	NBT		309
	SBT		400
	WBT		99
	NBL		114
	SBL		57
	WBL		5

Approach volumes and distributions		PHF
EB Volume 2035	494	0.97
EBL Proportion	*0.77*	
EBT Proportion	*0.18*	
EBR Proportion	*0.04*	
WB Volume 2035	135	
WBL Proportion	*0.03*	
WBT Proportion	*0.71*	
WBR Proportion	*0.25*	
NB Volume 2035	432	
NBL Proportion	*0.26*	
NBT Proportion	*0.69*	
NBR Proportion	*0.05*	
SBT/L Volume 2020	443	
SBL Proportion	*0.12*	
SBT Proportion	*0.88*	
SBR Volume 2020	885	

Step 3. Compute the conflicting flow rates

NOTE: The following equations are modified from the HCM to account for the unusual configuration of the US 95/Walnut Ave/Lincoln Way intersection.

	Movement	Conflicting Movements	Conflicting Flow Rate
Rank 3	NBR	EBT, 2 EBL, 1/2 EBR, 1/2 SBL	919
	WBR	2 EBL, 1/2 EBT, 1/2 NBT	987
Rank 4	NBT	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL	942
	SBT	EBT, 2 EBL, EBR, 1/2 WBT, 1/2 WBL, 1/2 NBL	1011
	WBT	EBT, 2 EBL, 1/2 EBR, 1/2 NBL, 1/2 NBT, 1/2 SBT, 1/2 SBL	1331
	NBL	EBT, 2 EBL, 1/2 EBR, 1/2 SBT, 1/2 WBT, 1/2 WBL	1142
	SBL	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL, 1/2 NBT	1097
	WBL	EBT, 2 EBL, EBR, 1/2 NBL, 1/2 NBT, 1/2 SBL, 1/2 SBT	1342

Step 4. Determine critical headways and follow-up headways

		t_c,base	P_HV	t_c	t_f,base	t_f		
							t_c,HV	1
Rank 3	NBR	6.2	0%	6.2	3.3	3.3	*no grade*	
	WBR	6.2	0%	6.2	3.3	3.3	*not a 3-leg intx*	
Rank 4	NBT	5.5	2%	5.5	4.0	4.0		
	SBT	5.5	2%	5.5	4.0	4.0	t_f,HV	0.9
	WBT	5.5	0%	5.5	4.0	4.0		
	NBL	6.1	0%	6.1	3.5	3.5		
	SBL	6.1	0%	6.1	3.5	3.5		
	WBL	6.1	0%	6.1	3.5	3.5		

Step 5. Compute potential capacities

No upstream signal present. The closest signal is approx. 0.5 mile.

		c_p,x
Rank 3	NBR	332
	WBR	303
Rank 4	NBT	341
	SBT	317
	WBT	226
	NBL	246
	SBL	261
	WBL	190

Step 6. Compute Rank 1 movement capacity

Not needed for analysis

Step 7. Compute Rank 2 movement capacity

No Rank 2 movements

Step 8. Compute Rank 3 movement capacity

		c_m,k		
Rank 3	NBR	332	f_k	1
	WBR	303		

Step 9. Compute Rank 4 movement capacity

Note: There are no higher rank queuing probabilities to account for in this intersection configuration.

		c_m,l
Rank 4	NBT	341
	SBT	317
	WBT	226
	NBL	246
	SBL	261
	WBL	190

Step 10. Final capacity adjustments

	c_SH
NBT/R	341
WBL/T/R	240
SBT/L	309

Step 11. Compute movement control delay

	v_x	c_m,x	d	LOS	v/c
NBT/R	330.9785	341	77	F	0.97
WBL/T/R	139.1753	240	39	E	0.58
SBT/L	456.701	309	263	F	1.48
NBL	114.3823	246	32	D	0.47

Step 12. Compute approach and intersection control delay

	d_A	v_A	
EB	5	509.2784	
WB	39	139.1753	
NB	66	445.3608	
SB	88	1369.072	Includes the SBR, which is a free right. Assumption: no delay on SBR.
d_I	64		

Step 13. Compute 95th percentile queue lengths

	Q_95 (veh)
NBT/R	11
WBL/T/R	3
SBT/L	25
NBL	2

Step 1. Determine and label movement priorities

Rank 1	EBR
	EBT
	EBL
	SBR
Rank 3	NBR
	WBR
Rank 4	NBT
	SBT
	WBT
	NBL
	SBL
	WBL

Step 2. Convert volumes to peak 15-min flow rates

		Peak 15 min	vph
Rank 1	EBR		23
	EBT		94
	EBL		393
	SBR		912
Rank 3	NBR		22
	WBR		35
Rank 4	NBT		309
	SBT		400
	WBT		99
	NBL		114
	SBL		57
	WBL		5

Approach volumes and distributions		PHF
EB Volume 2035	494	0.97
EBL Proportion	*0.77*	
EBT Proportion	*0.18*	
EBR Proportion	*0.04*	
WB Volume 2035	135	
WBL Proportion	*0.03*	
WBT Proportion	*0.71*	
WBR Proportion	*0.25*	
NB Volume 2035	432	
NBL Proportion	*0.26*	
NBT Proportion	*0.69*	
NBR Proportion	*0.05*	
SBT/L Volume 2020	443	
SBL Proportion	*0.12*	
SBT Proportion	*0.88*	
SBR Volume 2020	885	

Step 3. Compute the conflicting flow rates

NOTE: The following equations are modified from the HCM to account for the unusual configuration of the US 95/Walnut Ave/Lincoln Way intersection.

	Movement	Conflicting Movements	Conflicting Flow Rate
Rank 3	NBR	EBT, 2 EBL, 1/2 EBR, 1/2 SBL	919
	WBR	2 EBL, 1/2 EBT, 1/2 NBT	987
Rank 4	NBT	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL	942
	SBT	EBT, 2 EBL, EBR, 1/2 WBT, 1/2 WBL, 1/2 NBL	1011
	WBT	EBT, 2 EBL, 1/2 EBR, 1/2 NBL, 1/2 NBT, 1/2 SBT, 1/2 SBL	1331
	NBL	EBT, 2 EBL, 1/2 EBR, 1/2 SBT, 1/2 WBT, 1/2 WBL	1142
	SBL	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL, 1/2 NBT	1097
	WBL	EBT, 2 EBL, EBR, 1/2 NBL, 1/2 NBT, 1/2 SBL, 1/2 SBT	1342

Step 4. Determine critical headways and follow-up headways

		t_c,base	P_HV	t_c	t_f,base	t_f		
							t_c,HV	1
Rank 3	NBR	6.2	0%	6.2	3.3	3.3	*no grade*	
	WBR	6.2	0%	6.2	3.3	3.3	*not a 3-leg intx*	
Rank 4	NBT	5.5	2%	5.5	4.0	4.0		
	SBT	5.5	2%	5.5	4.0	4.0	t_f,HV	0.9
	WBT	5.5	0%	5.5	4.0	4.0		
	NBL	6.1	0%	6.1	3.5	3.5		
	SBL	6.1	0%	6.1	3.5	3.5		
	WBL	6.1	0%	6.1	3.5	3.5		

Step 5. Compute potential capacities

No upstream signal present. The closest signal is approx. 0.5 mile.

		c_p,x
Rank 3	NBR	332
	WBR	303
Rank 4	NBT	341
	SBT	317
	WBT	226
	NBL	246
	SBL	261
	WBL	190

Step 6. Compute Rank 1 movement capacity

Not needed for analysis

Step 7. Compute Rank 2 movement capacity

No Rank 2 movements

Step 8. Compute Rank 3 movement capacity

		c_m,k		
Rank 3	NBR	332	f_k	1
	WBR	303		

Step 9. Compute Rank 4 movement capacity

Note: There are no higher rank queuing probabilities to account for in this intersection configuration.

		c_m,l
Rank 4	NBT	341
	SBT	317
	WBT	226
	NBL	246
	SBL	261
	WBL	190

Step 10. Final capacity adjustments

	c_SH
NBT/R	341
WBL/T/R	240
SBT/L	309

Step 11. Compute movement control delay

	v_x	c_m,x	d	LOS	v/c
NBT/R	330.9785	341	77	F	0.97
WBL/T/R	139.1753	240	39	E	0.58
SBT/L	456.701	309	263	F	1.48
NBL	114.3823	246	32	D	0.47

Step 12. Compute approach and intersection control delay

	d_A	v_A	
EB	5	509.2784	
WB	39	139.1753	
NB	66	445.3608	
SB	88	1369.072	Includes the SBR, which is a free right. Assumption: no delay on SBR.
d_I	64		

Step 13. Compute 95th percentile queue lengths

	Q_95 (veh)
NBT/R	11
WBL/T/R	3
SBT/L	25
NBL	2

Step 1. Determine and label movement priorities

Rank 1	EBR
	EBT
	EBL
	SBR
Rank 3	NBR
	WBR
Rank 4	NBT
	SBT
	WBT
	NBL
	SBL
	WBL

Step 2. Convert volumes to peak 15-min flow rates

		Peak 15 min	vph
Rank 1	EBR		38
	EBT		157
	EBL		441
	SBR		1254
Rank 3	NBR		31
	WBR		26
Rank 4	NBT		579
	SBT		395
	WBT		86
	NBL		154
	SBL		56
	WBL		0

Approach volumes and distributions		PHF
EB Volume 2035	553	0.87
EBL Proportion	*0.69*	
EBT Proportion	*0.25*	
EBR Proportion	*0.06*	
WB Volume 2035	98	
WBL Proportion	*0.00*	
WBT Proportion	*0.76*	
WBR Proportion	*0.24*	
NB Volume 2035	664	
NBL Proportion	*0.20*	
NBT Proportion	*0.76*	
NBR Proportion	*0.04*	
SBT/L Volume 2035	392	
SBL Proportion	*0.12*	
SBT Proportion	*0.88*	
SBR Volume 2035	1091	

Step 3. Compute the conflicting flow rates

NOTE: The following equations are modified from the HCM to account for the unusual configuration of the US 95/Walnut Ave/Lincoln Way intersection.

	Movement	Conflicting Movements	Conflicting Flow Rate
Rank 3	NBR	EBT, 2 EBL, 1/2 EBR, 1/2 SBL	1085
	WBR	2 EBL, 1/2 EBT, 1/2 NBT	1249
Rank 4	NBT	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL	1101
	SBT	EBT, 2 EBL, EBR, 1/2 WBT, 1/2 WBL, 1/2 NBL	1196
	WBT	EBT, 2 EBL, 1/2 EBR, 1/2 NBL, 1/2 NBT, 1/2 SBT, 1/2 SBL	1649
	NBL	EBT, 2 EBL, 1/2 EBR, 1/2 SBT, 1/2 WBT, 1/2 WBL	1298
	SBL	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL, 1/2 NBT	1390
	WBL	EBT, 2 EBL, EBR, 1/2 NBL, 1/2 NBT, 1/2 SBL, 1/2 SBT	1668

Step 4. Determine critical headways and follow-up headways

		t_c,base	P_HV	t_c	t_f,base	t_f		
							t_c,HV	1
Rank 3	NBR	6.2	0%	6.2	3.3	3.3	*no grade*	
	WBR	6.2	0%	6.2	3.3	3.3	*not a 3-leg intx*	
Rank 4	NBT	5.5	2%	5.5	4.0	4.0		
	SBT	5.5	2%	5.5	4.0	4.0	t_f,HV	0.9
	WBT	5.5	0%	5.5	4.0	4.0		
	NBL	6.1	0%	6.1	3.5	3.5		
	SBL	6.1	0%	6.1	3.5	3.5		
	WBL	6.1	0%	6.1	3.5	3.5		

Step 5. Compute potential capacities

No upstream signal present. The closest signal is approx. 0.5 mile.

		c_p,x
Rank 3	NBR	266
	WBR	213
Rank 4	NBT	288
	SBT	259
	WBT	158
	NBL	201
	SBL	178
	WBL	123

Step 6. Compute Rank 1 movement capacity

Not needed for analysis

Step 7. Compute Rank 2 movement capacity

No Rank 2 movements

Step 8. Compute Rank 3 movement capacity

		c_m,k		
Rank 3	NBR	266	f_k	1
	WBR	213		

Step 9. Compute Rank 4 movement capacity

Note: There are no higher rank queuing probabilities to account for in this intersection configuration.

		c_m,l
Rank 4	NBT	288
	SBT	259
	WBT	158
	NBL	201
	SBL	178
	WBL	123

Step 10. Final capacity adjustments

	c_SH
NBT/R	287
WBL/T/R	168
SBT/L	245

Step 11. Compute movement control delay

	v_x	c_m,x	d	LOS	v/c
NBT/R	609.5503	287	547	F	2.13
WBL/T/R	112.5517	168	61	F	0.67
SBT/L	450.5747	245	426	F	1.84
NBL	153.6681	201	65	F	0.77

Step 12. Compute approach and intersection control delay

	d_A	v_A	
EB	5	635.6322	
WB	61	112.5517	
NB	450	763.2184	
SB	113	1704.598	Includes the SBR, which is a free right. Assumption: no delay on SBR.
d_I	170		

Step 13. Compute 95th percentile queue lengths

	Q_95 (veh)
NBT/R	45
WBL/T/R	4
SBT/L	31
NBL	5

Step 1. Determine and label movement priorities

Rank 1	EBR
	EBT
	EBL
	SBR
Rank 3	NBR
	WBR
Rank 4	NBT
	SBT
	WBT
	NBL
	SBL
	WBL

Step 2. Convert volumes to peak 15-min flow rates

		Peak 15 min	vph
Rank 1	EBR		26
	EBT		110
	EBL		459
	SBR		1041
Rank 3	NBR		45
	WBR		45
Rank 4	NBT		640
	SBT		571
	WBT		125
	NBL		237
	SBL		81
	WBL		6

Approach volumes and distributions		PHF
EB Volume 2035	578	0.97
EBL Proportion	*0.77*	
EBT Proportion	*0.18*	
EBR Proportion	*0.04*	
WB Volume 2035	170	
WBL Proportion	*0.03*	
WBT Proportion	*0.71*	
WBR Proportion	*0.25*	
NB Volume 2035	894	
NBL Proportion	*0.26*	
NBT Proportion	*0.69*	
NBR Proportion	*0.05*	
SBT/L Volume 2035	632	
SBL Proportion	*0.12*	
SBT Proportion	*0.88*	
SBR Volume 2035	1010	

Step 3. Compute the conflicting flow rates

NOTE: The following equations are modified from the HCM to account for the unusual configuration of the US 95/Walnut Ave/Lincoln Way intersection.

	Movement	Conflicting Movements	Conflicting Flow Rate
Rank 3	NBR	EBT, 2 EBL, 1/2 EBR, 1/2 SBL	1082
	WBR	2 EBL, 1/2 EBT, 1/2 NBT	1293
Rank 4	NBT	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL	1107
	SBT	EBT, 2 EBL, EBR, 1/2 WBT, 1/2 WBL, 1/2 NBL	1239
	WBT	EBT, 2 EBL, 1/2 EBR, 1/2 NBL, 1/2 NBT, 1/2 SBT, 1/2 SBL	1806
	NBL	EBT, 2 EBL, 1/2 EBR, 1/2 SBT, 1/2 WBT, 1/2 WBL	1393
	SBL	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL, 1/2 NBT	1427
	WBL	EBT, 2 EBL, EBR, 1/2 NBL, 1/2 NBT, 1/2 SBL, 1/2 SBT	1819

Step 4. Determine critical headways and follow-up headways

		t_c,base	P_HV	t_c	t_f,base	t_f		
							t_c,HV	1
Rank 3	NBR	6.2	0%	6.2	3.3	3.3	*no grade*	
	WBR	6.2	0%	6.2	3.3	3.3	*not a 3-leg intx*	
Rank 4	NBT	5.5	2%	5.5	4.0	4.0		
	SBT	5.5	2%	5.5	4.0	4.0	t_f,HV	0.9
	WBT	5.5	0%	5.5	4.0	4.0		
	NBL	6.1	0%	6.1	3.5	3.5		
	SBL	6.1	0%	6.1	3.5	3.5		
	WBL	6.1	0%	6.1	3.5	3.5		

Step 5. Compute potential capacities

No upstream signal present. The closest signal is approx. 0.5 mile.

		c_p,x
Rank 3	NBR	267
	WBR	201
Rank 4	NBT	286
	SBT	247
	WBT	132
	NBL	177
	SBL	169
	WBL	101

Step 6. Compute Rank 1 movement capacity

Not needed for analysis

Step 7. Compute Rank 2 movement capacity

No Rank 2 movements

Step 8. Compute Rank 3 movement capacity

		c_m,k		
Rank 3	NBR	267	f_k	1
	WBR	201		

Step 9. Compute Rank 4 movement capacity

Note: There are no higher rank queuing probabilities to account for in this intersection configuration.

		c_m,l
Rank 4	NBT	286
	SBT	247
	WBT	132
	NBL	177
	SBL	169
	WBL	101

Step 10. Final capacity adjustments

	c_SH
NBT/R	284
WBL/T/R	143
SBT/L	234

Step 11. Compute movement control delay

	v_x	c_m,x	d	LOS	v/c
NBT/R	684.9417	284	672	F	2.41
WBL/T/R	175.1753	143	209	F	1.22
SBT/L	651.5464	234	846	F	2.78
NBL	236.7078	177	234	F	1.33

Step 12. Compute approach and intersection control delay

	d_A	v_A	
EB	5	595.8763	
WB	209	175.1753	
NB	560	921.6495	
SB	326	1692.784	Includes the SBR, which is a free right. Assumption: no delay on SBR.
d_I	327		

Step 13. Compute 95th percentile queue lengths

	Q_95 (veh)
NBT/R	55
WBL/T/R	10
SBT/L	57
NBL	14

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	407	563	5	103	37	139	376	27	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	125	-	125	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	97	97	97	97	97	97	97	97	97	97	97	97
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	420	580	5	106	38	143	388	28	0	0	0

Major/Minor	Major1			Minor2			Minor1		
Conflicting Flow All	0	0	0	904	1000	0	782	710	710
Stage 1	-	-	-	0	0	-	710	710	-
Stage 2	-	-	-	904	1000	-	72	0	-
Critical Hdwy	-	-	-	6.42	6.52	-	6.42	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	5.42	5.52	-
Critical Hdwy Stg 2	-	-	-	5.42	5.52	-	-	-	-
Follow-up Hdwy	-	-	-	3.518	4.018	-	3.518	4.018	3.318
Pot Cap-1 Maneuver	-	-	-	307	243	-	363	~ 359	434
Stage 1	-	-	-	-	-	-	487	437	-
Stage 2	-	-	-	395	321	-	-	-	-
Platoon blocked, %		-	-						
Mov Cap-1 Maneuver	-	-	-	307	0	-	363	0	434
Mov Cap-2 Maneuver	-	-	-	307	0	-	363	0	-
Stage 1	-	-	-	-	0	-	487	0	-
Stage 2	-	-	-	395	0	-	-	0	-

Approach	EB	WB	NB
HCM Control Delay, s	0		
HCM LOS		-	-

Minor Lane/Major Mvmt	NBLn1	NBLn2	NBLn3	EBL	EBT	EBR	WBLn1
Capacity (veh/h)	363	-	434	-	-	-	-
HCM Lane V/C Ratio	0.395	-	0.064	-	-	-	-
HCM Control Delay (s)	21.2	-	13.9	0	-	-	-
HCM Lane LOS	C	-	B	A	-	-	-
HCM 95th %tile Q(veh)	1.8	-	0.2	-	-	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	1554.8

Movement	WBL	WBR	NET	NER	SWL	SWT
Vol, veh/h	242	0	1262	376	594	1218
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	150	0	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	97	97	97	97	97	97
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	249	0	1301	388	612	1256

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	3781	1301	0	0	1301	0
Stage 1	1301	-	-	-	-	-
Stage 2	2480	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	~ 5	197	-	-	~ 532	-
Stage 1	255	-	-	-	-	-
Stage 2	~ 65	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 5	197	-	-	~ 532	-
Mov Cap-2 Maneuver	~ 5	-	-	-	-	-
Stage 1	255	-	-	-	-	-
Stage 2	~ 65	-	-	-	-	-

Approach	WB	NE	SW
HCM Control Delay, s	$ 23440.3	0	37.4
HCM LOS	F		

Minor Lane/Major Mvmt	NET	NERWBLn1	SWL	SWT
Capacity (veh/h)	-	- 5	~ 532	-
HCM Lane V/C Ratio	-	- 49.897	1.151	-
HCM Control Delay (s)	-	$ 23440.3	114	-
HCM Lane LOS	-	- F	F	-
HCM 95th %tile Q(veh)	-	- 33.4	21	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Scenario 2 - Roundabout

LANE SUMMARY

Site: US 95 Ramps / Lincoln Way / Walnut Ave

HCM 2010 Ch 21 Example 1 - Single-lane Roundabout
SIDRA INTERSECTION defaults for US HCM (Customary) Model used
Roundabout

Lane Use and Performance

	Demand Flows				HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Length	SL Type	Cap. Adj.	Prob. Block.
	L	T	R	Total							Vehicles	Distance				
	veh/h	veh/h	veh/h	veh/h	%	veh/h	v/c	%	sec		veh	ft	ft		%	%
South: NB																
Lane 1	0	646	0	646	2.0	769	0.841	100	20.7	LOS C	13.3	338.9	1600	–	0.0	0.0
Lane 2	0	0	142	142	2.0	479[1]	0.297	100	9.8	LOS A	1.1	27.1	50	Turn Bay	0.0	0.0
Approach	0	646	142	789	2.0		0.841		18.7	LOS B	13.3	338.9				
East: WB																
Lane 1	26	0	8	34	2.0	479	0.071	100	17.4	LOS B	0.4	10.5	1600	–	0.0	0.0
Approach	26	0	8	34	2.0		0.071		17.4	LOS B	0.4	10.5				
North: SB																
Lane 1	133	527	0	660	2.0	1088	0.606	100	8.0	LOS A	6.9	176.4	1600	–	0.0	0.0
Approach	133	527	0	660	2.0		0.606		8.0	LOS A	6.9	176.4				
West: EB																
Lane 1	0	348	84	432	2.0	556	0.778	100	25.7	LOS C	9.6	242.7	1600	–	0.0	0.0
Approach	0	348	84	432	2.0		0.778		25.7	LOS C	9.6	242.7				
Intersection				1914	2.0		0.841		16.6	LOS B	13.3	338.9				

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

1 Reduced capacity due to a short lane effect

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Intersection	
Int Delay, s/veh	4.1

Movement	EBL	EBR	SEL	SET	SER	NWL	NWT	NWR	SWL	SWR
Vol, veh/h	0	99	151	354	0	0	279	225	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	-	None	-	-	None	-	-
Storage Length	0	200	105	-	-	-	-	120	-	-
Veh in Median Storage, #	0	-	-	0	-	-	0	-	0	-
Grade, %	0	-	-	0	-	-	0	-	0	-
Peak Hour Factor	97	97	97	97	97	97	97	97	97	97
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	102	156	365	0	0	288	232	0	0

Major/Minor	Minor1		Major1			Major2		
Conflicting Flow All	964	365	288	0	0	365	0	0
Stage 1	676	-	-	-	-	-	-	-
Stage 2	288	-	-	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	283	680	1274	-	-	1194	-	-
Stage 1	505	-	-	-	-	-	-	-
Stage 2	761	-	-	-	-	-	-	-
Platoon blocked, %				-	-		-	-
Mov Cap-1 Maneuver	248	680	1274	-	-	1194	-	-
Mov Cap-2 Maneuver	248	-	-	-	-	-	-	-
Stage 1	443	-	-	-	-	-	-	-
Stage 2	761	-	-	-	-	-	-	-

Approach	EB	SE	NW
HCM Control Delay, s	19.2	2.5	0
HCM LOS	C		

Minor Lane/Major Mvmt	NWL	NWT	NWR	EBLn1	EBLn2	SEL	SET	SER
Capacity (veh/h)	1194	-	-	248	680	1274	-	-
HCM Lane V/C Ratio	-	-	-	0.374	0.15	0.122	-	-
HCM Control Delay (s)	0	-	-	27.9	11.2	8.2	-	-
HCM Lane LOS	A	-	-	D	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	1.7	0.5	0.4	-	-

Intersection	
Int Delay, s/veh	8.2

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Vol, veh/h	0	301	15	37	332	0	0	0	0	234	0	53
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	105	-	-	-	-	-	150	-	0
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	97	97	97	97	97	97	97	97	97	97	97	97
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	310	15	38	342	0	0	0	0	241	0	55

Major/Minor	Major1			Major2			Minor2		
Conflicting Flow All	342	0	0	326	0	0	737	745	342
Stage 1	-	-	-	-	-	-	419	419	-
Stage 2	-	-	-	-	-	-	318	326	-
Critical Hdwy	4.12	-	-	4.12	-	-	6.42	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	5.42	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.42	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318
Pot Cap-1 Maneuver	1217	-	-	1234	-	-	386	342	701
Stage 1	-	-	-	-	-	-	664	590	-
Stage 2	-	-	-	-	-	-	738	648	-
Platoon blocked, %		-	-		-	-			
Mov Cap-1 Maneuver	1217	-	-	1234	-	-	374	0	701
Mov Cap-2 Maneuver	-	-	-	-	-	-	374	0	-
Stage 1	-	-	-	-	-	-	644	0	-
Stage 2	-	-	-	-	-	-	738	0	-

Approach	SE	NW	SW
HCM Control Delay, s	0	0.8	26.8
HCM LOS			D

Minor Lane/Major Mvmt	NWL	NWT	NWR	SEL	SET	SER	SWLn1	SWLn2
Capacity (veh/h)	1234	-	-	1217	-	-	374	701
HCM Lane V/C Ratio	0.031	-	-	-	-	-	0.645	0.078
HCM Control Delay (s)	8	-	-	0	-	-	30.5	10.6
HCM Lane LOS	A	-	-	A	-	-	D	B
HCM 95th %tile Q(veh)	0.1	-	-	0	-	-	4.3	0.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	284	1750	153	74	1172	25	157	294	164	38	43	14
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	293	1804	158	76	1208	26	162	303	169	39	44	14
Adj No. of Lanes	1	2	1	1	2	1	1	1	1	1	1	1
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	397	2124	950	161	1416	633	453	497	422	234	497	422
Arrive On Green	0.13	0.60	0.60	0.40	0.40	0.40	0.27	0.27	0.27	0.27	0.27	0.27
Sat Flow, veh/h	1774	3539	1583	223	3539	1583	1340	1863	1583	918	1863	1583
Grp Volume(v), veh/h	293	1804	158	76	1208	26	162	303	169	39	44	14
Grp Sat Flow(s),veh/h/ln	1774	1770	1583	223	1770	1583	1340	1863	1583	918	1863	1583
Q Serve(g_s), s	5.1	25.0	2.7	11.0	18.7	0.6	6.2	8.5	5.3	2.3	1.1	0.4
Cycle Q Clear(g_c), s	5.1	25.0	2.7	24.0	18.7	0.6	7.3	8.5	5.3	10.9	1.1	0.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	397	2124	950	161	1416	633	453	497	422	234	497	422
V/C Ratio(X)	0.74	0.85	0.17	0.47	0.85	0.04	0.36	0.61	0.40	0.17	0.09	0.03
Avail Cap(c_a), veh/h	397	2124	950	161	1416	633	453	497	422	234	497	422
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	12.0	9.8	5.3	27.0	16.4	11.0	19.3	19.3	18.1	24.0	16.5	16.3
Incr Delay (d2), s/veh	11.7	4.5	0.4	9.6	6.7	0.1	2.2	5.5	2.8	1.5	0.4	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.6	13.1	1.2	1.7	10.4	0.3	2.6	5.1	2.6	0.7	0.6	0.2
LnGrp Delay(d),s/veh	23.7	14.3	5.7	36.6	23.1	11.1	21.4	24.8	20.9	25.6	16.9	16.4
LnGrp LOS	C	B	A	D	C	B	C	C	C	C	B	B
Approach Vol, veh/h		2255			1310			634			97	
Approach Delay, s/veh		14.9			23.7			22.9			20.3	
Approach LOS		B			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6	7	8
Phs Duration (G+Y+Rc), s		20.0		40.0		20.0	12.0	28.0
Change Period (Y+Rc), s		4.0		4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		16.0		36.0		16.0	8.0	24.0
Max Q Clear Time (g_c+I1), s		10.5		27.0		12.9	7.1	26.0
Green Ext Time (p_c), s		1.7		8.8		1.1	0.1	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	18.9
HCM 2010 LOS	B

Step 1. Determine and label movement priorities

Rank 1	EBR
	EBT
Rank 3	NBR
	WBR
Rank 4	NBT
	WBL

Step 2. Convert volumes to peak 15-min flow rates

		Peak 15 min vph	PHF
Rank 1	EBR	55	0.97
	EBT	230	
	EBL	0	
	SBR	0	
Rank 3	NBR	149	
	WBR	108	
Rank 4	NBT	682	
	SBT	0	
	WBT	0	
	NBL	0	
	SBL	0	
	WBL	69	

Step 3. Compute the conflicting flow rates

NOTE: The following equations are modified from the HCM to account for the unusual configuration of the US 95/Walnut Ave/Lincoln Way intersection.

	Movement	Conflicting Movements	Conflicting Flow Rate
Rank 3	NBR	EBT, 2 EBL, 1/2 SBL	230
	WBR	2 EBL, 1/2 EBT, 1/2 NBT	456
Rank 4	NBT	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL	264
	SBT	EBT, 2 EBL, EBR, 1/2 WBT, 1/2 WBL, 1/2 NBL	319
	WBT	EBT, 2 EBL, 1/2 EBR, 1/2 NBL, 1/2 NBT, 1/2 SBT, 1/2 SBL	598
	NBL	EBT, 2 EBL, 1/2 EBR, 1/2 SBT, 1/2 WBT, 1/2 WBL	292
	SBL	EBT, 2 EBL, 1/2 EBR, 1/2 WBT, 1/2 WBL, 1/2 NBT	633
	WBL	EBT, 2 EBL, EBR, 1/2 NBL, 1/2 NBT, 1/2 SBL, 1/2 SBT	626

Step 4. Determine critical headways and follow-up headways

		t_c,base	P_HV	t_c	t_f,base	t_f	t_c,HV	1
Rank 3	NBR	6.2	0%	6.2	3.3	3.3	*no grade*	
	WBR	6.2	0%	6.2	3.3	3.3	*not a 3-leg intx*	
Rank 4	NBT	5.5	2%	5.5	4.0	4.0		
	NBL	6.1	0%	6.1	3.5	3.5	t_f,HV	0.9
	SBL	6.1	0%	6.1	3.5	3.5		
	WBL	6.1	0%	6.1	3.5	3.5		

Step 5. Compute potential capacities

No upstream signal present. The closest signal is approx. 0.5 mile.

		c_p,x			
Rank 3	NBR	814	Rank 4	NBT	690
	WBR	608		NBL	721
				SBL	471
				WBL	476

Step 6. Compute Rank 1 movement capacity

Not needed for analysis

Step 7. Compute Rank 2 movement capacity

No Rank 2 movements

Step 8. Compute Rank 3 movement capacity

		c_m,k		
Rank 3	NBR	814	f_k	1
	WBR	608		

Step 9. Compute Rank 4 movement capacity

Note: There are no higher rank queuing probabilities to account for in this intersection configuration.

		c_m,l
Rank 4	NBT	690
	NBL	721
	SBL	471
	WBL	476

Step 10. Final capacity adjustments

	c_SH
NBT	690
NBR	814
WBL/R	549

Step 11. Compute movement control delay

	v_x	c_m,x	d	v/c	LOS
NBT	682	690	56	0.99	F
NBR	149	814	10	0.18	B
WBL/R	177	549	15	0.32	B

Step 12. Compute approach and intersection control delay

	d_A	v_A
EB	5	284.5361
WB	15	177.3196
NB	56	831.9588
d_I	39	

Step 13. Compute 95th percentile queue lengths

	Q_95 (veh)
NBT/R	16
WBL/R	1

Intersection	
Int Delay, s/veh	1.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	0	46	40	0	63	0	907	199	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Stop	Stop	Stop	Free	Free	Free	Yield	Yield	Yield
RT Channelized	-	-	Free	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	-	-	-	150	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	97	97	97	97	97	97	97	97	97	97	97	97
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	47	41	0	65	0	935	205	0	0	0

Major/Minor	Major1			Minor2			Major2		
Conflicting Flow All	-	-	-	935	935	935	0	0	0
Stage 1	-	-	-	935	935	-	-	-	-
Stage 2	-	-	-	0	0	-	-	-	-
Critical Hdwy	-	-	-	6.42	6.52	6.22	-	-	-
Critical Hdwy Stg 1	-	-	-	5.42	5.52	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	3.518	4.018	3.318	-	-	-
Pot Cap-1 Maneuver	0	0	0	295	265	322	-	-	-
Stage 1	0	0	0	382	344	-	-	-	-
Stage 2	0	0	0	-	-	-	-	-	-
Platoon blocked, %	-	-						-	-
Mov Cap-1 Maneuver	-	-	-	295	0	322	-	-	-
Mov Cap-2 Maneuver	-	-	-	295	0	-	-	-	-
Stage 1	-	-	-	382	0	-	-	-	-
Stage 2	-	-	-	-	0	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	22.5	0
HCM LOS		C	

Minor Lane/Major Mvmt	NBL	NBT	NBR	WBLn1
Capacity (veh/h)	-	-	-	311
HCM Lane V/C Ratio	-	-	-	0.341
HCM Control Delay (s)	0	-	-	22.5
HCM Lane LOS	A	-	-	C
HCM 95th %tile Q(veh)	-	-	-	1.5

Intersection	
Int Delay, s/veh	8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	105	165	705	155	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Yield	Yield
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	150	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	107	168	719	158	0	0

Major/Minor	Minor1		Major1	
Conflicting Flow All	719	719	0	0
Stage 1	719	-	-	-
Stage 2	0	-	-	-
Critical Hdwy	7.12	6.22	-	-
Critical Hdwy Stg 1	6.12	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-
Pot Cap-1 Maneuver	344	428	-	-
Stage 1	420	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	344	428	-	-
Mov Cap-2 Maneuver	344	-	-	-
Stage 1	420	-	-	-
Stage 2	-	-	-	-

Approach	WB	NB
HCM Control Delay, s	33.4	0
HCM LOS	D	

Minor Lane/Major Mvmt	NBT	NBR	WBLn1
Capacity (veh/h)	-	-	391
HCM Lane V/C Ratio	-	-	0.705
HCM Control Delay (s)	-	-	33.4
HCM Lane LOS	-	-	D
HCM 95th %tile Q(veh)	-	-	5.2

Intersection	
Int Delay, s/veh	0

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	0	46	60	0	0	199
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Stop	Stop	Free	Free
RT Channelized	-	Free	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	97	97	97	97	97	97
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	47	62	0	0	205

Major/Minor	Major1		Minor2		Major2	
Conflicting Flow All	-	-	0	0	0	-
Stage 1	-	-	0	0	-	-
Stage 2	-	-	0	0	-	-
Critical Hdwy	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	-	-	-	-
Stage 1	0	0	-	-	-	-
Stage 2	0	0	-	-	-	-
Platoon blocked, %	-					-
Mov Cap-1 Maneuver	-	-	-	0	-	-
Mov Cap-2 Maneuver	-	-	-	0	-	-
Stage 1	-	-	-	0	-	-
Stage 2	-	-	-	0	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0		0
HCM LOS		-	

Minor Lane/Major Mvmt	NBL	NBR	WBLn1
Capacity (veh/h)	-	-	-
HCM Lane V/C Ratio	-	-	-
HCM Control Delay (s)	0	-	-
HCM Lane LOS	A	-	-
HCM 95th %tile Q(veh)	-	-	-

Appendix D: NETWORK ANALYSIS

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc
Date Performed: 9/12/2013
Analysis Time Period: AM Peak Hour
Intersection: US 95 / NW Blvd NB
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035, existing layout
Project ID: US 95 Corridor Study
East/West Street: US 95
North/South Street: NW Blvd NB
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		705			1179	
Peak-Hour Factor, PHF		0.95			0.95	
Hourly Flow Rate, HFR		742			1241	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		1			1	
Configuration		T			T	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	99	0	1			
Peak Hour Factor, PHF	0.95	0.95	0.95			
Hourly Flow Rate, HFR	104	0	1			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes /1			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config				LTR				
v (vph)				105				
C(m) (vph)				69				
v/c				1.52				
95% queue length				8.92				
Control Delay				397.1				
LOS				F				
Approach Delay				397.1				
Approach LOS				F				

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc
Date Performed: 9/12/2013
Analysis Time Period: AM Peak Hour
Intersection: US 95 / NW Blvd NB
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035, existing layout
Project ID: US 95 Corridor Study
East/West Street: US 95
North/South Street: NW Blvd NB
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		705			1179	
Peak-Hour Factor, PHF		0.95			0.95	
Peak-15 Minute Volume		186			310	
Hourly Flow Rate, HFR		742			1241	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1			1	
Configuration		T			T	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	99	0	1			
Peak Hour Factor, PHF	0.95	0.95	0.95			
Peak-15 Minute Volume	26	0	0			
Hourly Flow Rate, HFR	104	0	1			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes	/1		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			7.1	6.5	6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0	0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70	0.00	0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4	6.5	6.2			
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)			3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			0	0	0			
t(f)			3.5	4.0	3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x			1983	1983	742			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	742	
Potential Capacity	419	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	419	
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1983	
Potential Capacity	62	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	62	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1983	
Potential Capacity	68	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	68	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1983	

Potential Capacity	62	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	62	

Result for 2 stage process:
a
y
C t

	62	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage

Conflicting Flows	1983	
Potential Capacity	68	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	68	

Results for Two-stage process:
a
y
C t

	68

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	104	0	1			
Movement Capacity (vph)	68	62	419			
Shared Lane Capacity (vph)		69				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	68	62	419			
Volume	104	0	1			
Delay	402.1	63.1	13.6			
Q sep	11.62	0.00	0.00			
Q sep +1	12.62	1.00	1.00			
round (Qsep +1)	13	1	1			

n max	13
C sh	69
SUM C sep	69
n	1
C act	69

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config				LTR				
v (vph)				105				
C(m) (vph)				69				
v/c				1.52				
95% queue length				8.92				
Control Delay				397.1				
LOS				F				
Approach Delay				397.1				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc
Date Performed: 9/12/2013
Analysis Time Period: PM Peak Hour
Intersection: US 95 / NW Blvd NB
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035, existing layout
Project ID: US 95 Corridor Study
East/West Street: US 95
North/South Street: NW Blvd NB
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		900			1041	
Peak-Hour Factor, PHF		0.95			0.95	
Hourly Flow Rate, HFR		947			1095	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		1			1	
Configuration		T			T	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	335	0	447			
Peak Hour Factor, PHF	0.95	0.95	0.95			
Hourly Flow Rate, HFR	352	0	470			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes /1			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config				LTR				
v (vph)				822				
C(m) (vph)				116				
v/c				7.09				
95% queue length				91.61				
Control Delay				2810				
LOS				F				
Approach Delay				2810				
Approach LOS				F				

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc
Date Performed: 9/12/2013
Analysis Time Period: PM Peak Hour
Intersection: US 95 / NW Blvd NB
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035, existing layout
Project ID: US 95 Corridor Study
East/West Street: US 95
North/South Street: NW Blvd NB
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		900			1041	
Peak-Hour Factor, PHF		0.95			0.95	
Peak-15 Minute Volume		237			274	
Hourly Flow Rate, HFR		947			1095	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1			1	
Configuration		T			T	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	335	0	447			
Peak Hour Factor, PHF	0.95	0.95	0.95			
Peak-15 Minute Volume	88	0	118			
Hourly Flow Rate, HFR	352	0	470			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes	/1		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			7.1	6.5	6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0	0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70	0.00	0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4	6.5	6.2			
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)			3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			0	0	0			
t(f)			3.5	4.0	3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x			2042	2042	947			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	947	
Potential Capacity	319	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	319	
Probability of Queue free St.	0.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	2042	
Potential Capacity	57	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	57	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	2042	
Potential Capacity	63	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.00
Movement Capacity	63	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	2042	

Potential Capacity	57	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	57	

Result for 2 stage process:
a
y
C t 57
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage		
Conflicting Flows	2042	
Potential Capacity	63	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.00
Movement Capacity	63	

Results for Two-stage process:
a
y
C t 63

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	352	0	470			
Movement Capacity (vph)	63	57	319			
Shared Lane Capacity (vph)		116				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	63	57	319			
Volume	352	0	470			
Delay	2193.8	68.2	260.0			
Q sep	214.51	0.00	33.94			
Q sep +1	215.51	1.00	34.94			
round (Qsep +1)	216	1	35			

n max	216
C sh	116
SUM C sep	147
n	1
C act	116

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config				LTR				
v (vph)				822				
C(m) (vph)				116				
v/c				7.09				
95% queue length				91.61				
Control Delay				2810				
LOS				F				
Approach Delay				2810				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc
Date Performed: 9/12/2013
Analysis Time Period: PM Peak Hour
Intersection: US 95 / NW Blvd NB
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year:
Project ID: US 95 Corridor Study
East/West Street: US 95
North/South Street: NW Blvd NB
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1000			1063	
Peak-Hour Factor, PHF		0.95			0.95	
Hourly Flow Rate, HFR		1052			1118	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		1			1	
Configuration		T			T	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	196	0	365			
Peak Hour Factor, PHF	0.95	0.95	0.95			
Hourly Flow Rate, HFR	206	0	384			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes /1			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config				LTR				
v (vph)				590				
C(m) (vph)				110				
v/c				5.36				
95% queue length				63.49				
Control Delay				2041				
LOS				F				
Approach Delay				2041				
Approach LOS				F				

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc
Date Performed: 9/12/2013
Analysis Time Period: PM Peak Hour
Intersection: US 95 / NW Blvd NB
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year:
Project ID: US 95 Corridor Study
East/West Street: US 95
North/South Street: NW Blvd NB
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1000			1063	
Peak-Hour Factor, PHF		0.95			0.95	
Peak-15 Minute Volume		263			280	
Hourly Flow Rate, HFR		1052			1118	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1			1	
Configuration		T			T	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	196	0	365			
Peak Hour Factor, PHF	0.95	0.95	0.95			
Peak-15 Minute Volume	52	0	96			
Hourly Flow Rate, HFR	206	0	384			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes	/1		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			7.1	6.5	6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0	0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70	0.00	0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4	6.5	6.2			
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)			3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			0	0	0			
t(f)			3.5	4.0	3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x			2170	2170	1052			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	1052	
Potential Capacity	278	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	278	
Probability of Queue free St.	0.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	2170	
Potential Capacity	47	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	47	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	2170	
Potential Capacity	52	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.00
Movement Capacity	52	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	2170	

Potential Capacity	47	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	47	

Result for 2 stage process:
a
y
C t 47
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage		
Conflicting Flows	2170	
Potential Capacity	52	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.00
Movement Capacity	52	

Results for Two-stage process:
a
y
C t 52

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	206	0	384			
Movement Capacity (vph)	52	47	278			
Shared Lane Capacity (vph)		110				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	52	47	278			
Volume	206	0	384			
Delay	1493.9	81.6	227.9			
Q sep	85.48	0.00	24.31			
Q sep +1	86.48	1.00	25.31			
round (Qsep +1)	86	1	25			

n max	86
C sh	110
SUM C sep	149
n	1
C act	110

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config				LTR				
v (vph)				590				
C(m) (vph)				110				
v/c				5.36				
95% queue length				63.49				
Control Delay				2041				
LOS				F				
Approach Delay				2041				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc
Date Performed: 9/12/2013
Analysis Time Period: AM Peak Hour
Intersection: US 95 / NW Blvd NB
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: US 95
North/South Street: NW Blvd NB
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		751			970	
Peak-Hour Factor, PHF		0.95			0.95	
Hourly Flow Rate, HFR		790			1021	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		1			1	
Configuration		T			T	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	142	0	75			
Peak Hour Factor, PHF	0.95	0.95	0.95			
Hourly Flow Rate, HFR	149	0	78			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes /1			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config				LTR				
v (vph)				227				
C(m) (vph)				120				
v/c				1.89				
95% queue length				18.08				
Control Delay				492.1				
LOS				F				
Approach Delay				492.1				
Approach LOS				F				

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: C. DeLorto
Agency/Co.: HDR Engineering, Inc
Date Performed: 9/12/2013
Analysis Time Period: AM Peak Hour
Intersection: US 95 / NW Blvd NB
Jurisdiction: ITD
Units: U. S. Customary
Analysis Year: 2035
Project ID: US 95 Corridor Study
East/West Street: US 95
North/South Street: NW Blvd NB
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		751			970	
Peak-Hour Factor, PHF		0.95			0.95	
Peak-15 Minute Volume		198			255	
Hourly Flow Rate, HFR		790			1021	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1			1	
Configuration		T			T	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	142	0	75			
Peak Hour Factor, PHF	0.95	0.95	0.95			
Peak-15 Minute Volume	37	0	20			
Hourly Flow Rate, HFR	149	0	78			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes	/1		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			7.1	6.5	6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0	0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70	0.00	0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4	6.5	6.2			
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)			3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			0	0	0			
t(f)			3.5	4.0	3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x			1811	1811	790			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	790	
Potential Capacity	393	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	393	
Probability of Queue free St.	0.80	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1811	
Potential Capacity	79	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	79	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1811	
Potential Capacity	87	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.80
Movement Capacity	87	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1811	

Potential Capacity	79	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	79	

Result for 2 stage process:
a
y
C t

	79	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage

Conflicting Flows	1811	
Potential Capacity	87	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.80
Movement Capacity	87	

Results for Two-stage process:
a
y
C t

	87

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	149	0	78			
Movement Capacity (vph)	87	79	393			
Shared Lane Capacity (vph)		119				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	87	79	393			
Volume	149	0	78			
Delay	446.7	50.6	16.4			
Q sep	18.49	0.00	0.36			
Q sep +1	19.49	1.00	1.36			
round (Qsep +1)	19	1	1			

n max	19
C sh	119
SUM C sep	133
n	1
C act	120

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config				LTR				
v (vph)				227				
C(m) (vph)				120				
v/c				1.89				
95% queue length				18.08				
Control Delay				492.1				
LOS				F				
Approach Delay				492.1				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	95	80	20	72	50	283	35	252	45	106	626	120
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	100	84	21	76	53	298	37	265	47	112	659	126
Adj No. of Lanes	1	1	0	1	1	1	1	2	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	341	322	81	360	417	484	51	1416	248	145	796	152
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.03	0.47	0.47	0.08	0.52	0.52
Sat Flow, veh/h	1026	1439	360	1284	1863	1583	1774	3012	527	1774	1521	291
Grp Volume(v), veh/h	100	0	105	76	53	298	37	154	158	112	0	785
Grp Sat Flow(s),veh/h/ln	1026	0	1799	1284	1863	1583	1774	1770	1770	1774	0	1811
Q Serve(g_s), s	4.6	0.0	2.6	2.8	1.2	8.6	1.1	2.7	2.8	3.3	0.0	19.5
Cycle Q Clear(g_c), s	5.8	0.0	2.6	5.3	1.2	8.6	1.1	2.7	2.8	3.3	0.0	19.5
Prop In Lane	1.00		0.20	1.00		1.00	1.00		0.30	1.00		0.16
Lane Grp Cap(c), veh/h	341	0	403	360	417	484	51	832	832	145	0	948
V/C Ratio(X)	0.29	0.00	0.26	0.21	0.13	0.62	0.73	0.19	0.19	0.77	0.00	0.83
Avail Cap(c_a), veh/h	418	0	538	457	557	603	133	832	832	298	0	948
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	18.9	0.0	17.1	19.3	16.6	15.9	25.8	8.2	8.2	24.1	0.0	10.7
Incr Delay (d2), s/veh	0.5	0.0	0.3	0.3	0.1	1.3	17.9	0.5	0.5	8.5	0.0	8.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	1.3	1.0	0.6	3.9	0.8	1.4	1.5	2.0	0.0	11.8
LnGrp Delay(d),s/veh	19.4	0.0	17.5	19.6	16.7	17.2	43.7	8.7	8.8	32.5	0.0	19.0
LnGrp LOS	B		B	B	B	B	D	A	A	C		B
Approach Vol, veh/h		205			427			349			897	
Approach Delay, s/veh		18.4			17.5			12.4			20.7	
Approach LOS		B			B			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.4	29.2		16.0	5.5	32.0		16.0
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	9.0	23.0		16.0	4.0	28.0		16.0
Max Q Clear Time (g_c+I1), s	5.3	4.8		7.8	3.1	21.5		10.6
Green Ext Time (p_c), s	0.1	1.8		1.8	0.0	3.0		1.4

Intersection Summary	
HCM 2010 Ctrl Delay	18.2
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	292	60	14	29	30	310	16	251	10	134	660	245
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	307	63	15	31	32	326	17	264	11	141	695	258
Adj No. of Lanes	1	1	0	1	1	1	1	2	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	338	410	98	258	306	417	24	1656	69	176	731	271
Arrive On Green	0.07	0.28	0.28	0.16	0.16	0.16	0.01	0.48	0.48	0.10	0.56	0.56
Sat Flow, veh/h	1774	1455	346	1316	1863	1583	1774	3463	144	1774	1297	481
Grp Volume(v), veh/h	307	0	78	31	32	326	17	134	141	141	0	953
Grp Sat Flow(s),veh/h/ln	1774	0	1802	1316	1863	1583	1774	1770	1837	1774	0	1778
Q Serve(g_s), s	4.2	0.0	2.8	1.8	1.2	11.6	0.8	3.7	3.7	6.6	0.0	42.9
Cycle Q Clear(g_c), s	4.2	0.0	2.8	4.6	1.2	11.6	0.8	3.7	3.7	6.6	0.0	42.9
Prop In Lane	1.00		0.19	1.00		1.00	1.00		0.08	1.00		0.27
Lane Grp Cap(c), veh/h	338	0	507	258	306	417	24	846	878	176	0	1003
V/C Ratio(X)	0.91	0.00	0.15	0.12	0.10	0.78	0.71	0.16	0.16	0.80	0.00	0.95
Avail Cap(c_a), veh/h	338	0	550	289	350	455	83	846	878	292	0	1003
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	35.0	0.0	23.0	32.9	30.3	15.5	41.8	12.5	12.6	37.5	0.0	17.4
Incr Delay (d2), s/veh	27.2	0.0	0.1	0.2	0.1	7.9	32.1	0.4	0.4	8.1	0.0	18.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.6	0.0	1.4	0.7	0.7	6.0	0.6	1.9	2.0	3.6	0.0	26.1
LnGrp Delay(d),s/veh	62.2	0.0	23.1	33.1	30.4	23.5	73.9	12.9	12.9	45.6	0.0	36.2
LnGrp LOS	E		C	C	C	C	E	B	B	D		D
Approach Vol, veh/h		385			389			292			1094	
Approach Delay, s/veh		54.3			24.8			16.5			37.4	
Approach LOS		D			C			B			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.5	44.7		28.0	5.1	52.0	10.0	18.0
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0	4.0	4.0
Max Green Setting (Gmax), s	14.0	38.0		26.0	4.0	48.0	6.0	16.0
Max Q Clear Time (g_c+I1), s	8.6	5.7		4.8	2.8	44.9	6.2	13.6
Green Ext Time (p_c), s	0.2	1.7		1.3	0.0	2.0	0.0	0.4

Intersection Summary	
HCM 2010 Ctrl Delay	35.3
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	292	60	14	29	30	310	16	251	10	134	660	245
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	307	63	15	31	32	326	17	264	11	141	695	258
Adj No. of Lanes	2	1	0	1	1	1	1	2	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	423	110	26	337	123	382	133	1402	58	747	731	271
Arrive On Green	0.12	0.08	0.08	0.11	0.07	0.07	0.02	0.40	0.40	0.18	0.56	0.56
Sat Flow, veh/h	3442	1455	346	1774	1863	1583	1774	3463	144	1774	1297	481
Grp Volume(v), veh/h	307	0	78	31	32	326	17	134	141	141	0	953
Grp Sat Flow(s),veh/h/ln	1721	0	1802	1774	1863	1583	1774	1770	1837	1774	0	1778
Q Serve(g_s), s	5.9	0.0	2.9	0.0	1.1	1.5	0.4	3.4	3.4	0.0	0.0	34.9
Cycle Q Clear(g_c), s	5.9	0.0	2.9	0.0	1.1	1.5	0.4	3.4	3.4	0.0	0.0	34.9
Prop In Lane	1.00		0.19	1.00		1.00	1.00		0.08	1.00		0.27
Lane Grp Cap(c), veh/h	423	0	136	337	123	382	133	716	744	747	0	1002
V/C Ratio(X)	0.73	0.00	0.58	0.09	0.26	0.85	0.13	0.19	0.19	0.19	0.00	0.95
Avail Cap(c_a), veh/h	696	0	651	337	431	643	232	716	744	846	0	1002
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	29.2	0.0	30.9	26.3	30.7	25.1	18.1	13.3	13.3	10.9	0.0	14.2
Incr Delay (d2), s/veh	2.4	0.0	3.8	0.1	1.1	5.8	0.4	0.6	0.6	0.1	0.0	18.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.0	0.0	1.6	0.5	0.6	6.3	0.2	1.8	1.8	1.6	0.0	21.9
LnGrp Delay(d),s/veh	31.6	0.0	34.7	26.5	31.8	30.8	18.5	13.8	13.8	11.0	0.0	33.0
LnGrp LOS	C		C	C	C	C	B	B	B	B		C
Approach Vol, veh/h		385			389			292			1094	
Approach Delay, s/veh		32.2			30.6			14.1			30.2	
Approach LOS		C			C			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	16.1	32.0	11.9	9.2	5.1	43.0	12.5	8.6
Change Period (Y+Rc), s	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Max Green Setting (Gmax), s	16.0	28.0	5.0	25.0	5.0	39.0	14.0	16.0
Max Q Clear Time (g_c+I1), s	2.0	5.4	2.0	4.9	2.4	36.9	7.9	3.5
Green Ext Time (p_c), s	6.9	1.5	0.4	0.3	0.0	1.5	0.6	1.1

Intersection Summary	
HCM 2010 Ctrl Delay	28.4
HCM 2010 LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	140	70	41	15	115	486	45	897	50	34	587	98
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	147	74	43	16	121	512	47	944	53	36	618	103
Adj No. of Lanes	1	1	0	1	1	1	1	2	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	339	337	196	460	567	531	54	1488	84	55	681	113
Arrive On Green	0.30	0.30	0.30	0.30	0.30	0.30	0.03	0.44	0.44	0.03	0.44	0.44
Sat Flow, veh/h	791	1106	643	1270	1863	1583	1774	3407	191	1774	1557	260
Grp Volume(v), veh/h	147	0	117	16	121	512	47	490	507	36	0	721
Grp Sat Flow(s),veh/h/ln	791	0	1749	1270	1863	1583	1774	1770	1829	1774	0	1817
Q Serve(g_s), s	8.9	0.0	2.6	0.5	2.5	16.0	1.4	11.4	11.4	1.1	0.0	19.5
Cycle Q Clear(g_c), s	11.5	0.0	2.6	3.1	2.5	16.0	1.4	11.4	11.4	1.1	0.0	19.5
Prop In Lane	1.00		0.37	1.00		1.00	1.00		0.10	1.00		0.14
Lane Grp Cap(c), veh/h	339	0	532	460	567	531	54	773	799	55	0	794
V/C Ratio(X)	0.43	0.00	0.22	0.03	0.21	0.96	0.87	0.63	0.63	0.65	0.00	0.91
Avail Cap(c_a), veh/h	339	0	532	460	567	531	135	773	799	236	0	794
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	17.9	0.0	13.6	14.8	13.6	17.2	25.4	11.5	11.5	25.2	0.0	13.8
Incr Delay (d2), s/veh	0.9	0.0	0.2	0.0	0.2	30.1	31.2	4.0	3.8	12.3	0.0	16.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.0	0.0	1.3	0.2	1.3	11.7	1.1	6.3	6.5	0.7	0.0	13.2
LnGrp Delay(d),s/veh	18.8	0.0	13.9	14.8	13.8	47.3	56.5	15.5	15.4	37.5	0.0	29.9
LnGrp LOS	B		B	B	B	D	E	B	B	D		C
Approach Vol, veh/h		264			649			1044			757	
Approach Delay, s/veh		16.6			40.3			17.3			30.2	
Approach LOS		B			D			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	5.6	27.0		20.0	5.6	27.0		20.0
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	7.0	20.0		16.0	4.0	23.0		16.0
Max Q Clear Time (g_c+I1), s	3.1	13.4		13.5	3.4	21.5		18.0
Green Ext Time (p_c), s	0.0	3.5		1.2	0.0	0.8		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	26.3
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	577	80	44	22	25	460	15	893	9	115	582	169
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	607	84	46	23	26	484	16	940	9	121	613	178
Adj No. of Lanes	1	1	0	1	1	1	1	2	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	622	493	270	180	259	496	63	1031	10	381	688	200
Arrive On Green	0.26	0.43	0.43	0.14	0.14	0.14	0.29	0.29	0.29	0.17	0.50	0.50
Sat Flow, veh/h	1774	1133	620	1255	1863	1583	683	3592	34	1774	1388	403
Grp Volume(v), veh/h	607	0	130	23	26	484	16	463	486	121	0	791
Grp Sat Flow(s),veh/h/ln	1774	0	1753	1255	1863	1583	683	1770	1857	1774	0	1792
Q Serve(g_s), s	28.5	0.0	5.2	1.9	1.4	14.8	0.0	29.1	29.1	1.9	0.0	45.9
Cycle Q Clear(g_c), s	28.5	0.0	5.2	7.2	1.4	14.8	33.0	29.1	29.1	1.9	0.0	45.9
Prop In Lane	1.00		0.35	1.00		1.00	1.00		0.02	1.00		0.23
Lane Grp Cap(c), veh/h	622	0	762	180	259	496	63	508	533	381	0	888
V/C Ratio(X)	0.98	0.00	0.17	0.13	0.10	0.98	0.26	0.91	0.91	0.32	0.00	0.89
Avail Cap(c_a), veh/h	622	0	762	180	259	496	63	508	533	381	0	888
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	37.2	0.0	19.8	48.1	43.2	39.1	57.5	39.6	39.6	39.4	0.0	26.2
Incr Delay (d2), s/veh	29.8	0.0	0.1	0.3	0.2	34.3	9.6	23.2	22.4	0.5	0.0	13.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	24.2	0.0	2.5	0.7	0.7	11.1	0.7	17.4	18.2	3.3	0.0	25.9
LnGrp Delay(d),s/veh	66.9	0.0	19.9	48.4	43.4	73.4	67.1	62.8	62.0	39.9	0.0	39.2
LnGrp LOS	E		B	D	D	E	E	E	E	D		D
Approach Vol, veh/h		737			533			965			912	
Approach Delay, s/veh		58.7			70.8			62.4			39.3	
Approach LOS		E			E			E			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6	7	8
Phs Duration (G+Y+Rc), s	24.0	37.0		54.0		61.0	34.0	20.0
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s	20.0	33.0		50.0		57.0	30.0	16.0
Max Q Clear Time (g_c+I1), s	3.9	35.0		7.2		47.9	30.5	16.8
Green Ext Time (p_c), s	5.8	0.0		3.1		4.1	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	56.3
HCM 2010 LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	577	80	44	22	25	460	15	893	9	115	582	169
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	607	84	46	23	26	484	16	940	9	121	613	178
Adj No. of Lanes	2	1	0	1	1	1	1	2	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	680	113	62	333	85	527	105	1059	10	602	788	229
Arrive On Green	0.20	0.10	0.10	0.14	0.05	0.05	0.01	0.29	0.29	0.29	0.57	0.57
Sat Flow, veh/h	3442	1133	620	1774	1863	1583	1774	3592	34	1774	1388	403
Grp Volume(v), veh/h	607	0	130	23	26	484	16	463	486	121	0	791
Grp Sat Flow(s),veh/h/ln	1721	0	1753	1774	1863	1583	1774	1770	1857	1774	0	1792
Q Serve(g_s), s	15.7	0.0	6.6	0.0	1.2	0.6	0.0	22.9	22.9	0.0	0.0	31.3
Cycle Q Clear(g_c), s	15.7	0.0	6.6	0.0	1.2	0.6	0.0	22.9	22.9	0.0	0.0	31.3
Prop In Lane	1.00		0.35	1.00		1.00	1.00		0.02	1.00		0.23
Lane Grp Cap(c), veh/h	680	0	174	333	85	527	105	522	547	602	0	1017
V/C Ratio(X)	0.89	0.00	0.75	0.07	0.31	0.92	0.15	0.89	0.89	0.20	0.00	0.78
Avail Cap(c_a), veh/h	714	0	421	333	163	594	175	522	547	673	0	1017
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	35.8	0.0	40.1	33.6	42.3	29.3	44.5	30.9	30.9	23.1	0.0	15.3
Incr Delay (d2), s/veh	13.2	0.0	6.2	0.1	2.0	18.2	0.7	19.7	18.9	0.2	0.0	5.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.8	0.0	3.5	0.5	0.7	14.1	0.4	14.0	14.6	2.2	0.0	17.0
LnGrp Delay(d),s/veh	49.0	0.0	46.3	33.7	44.3	47.5	45.1	50.5	49.8	23.3	0.0	21.2
LnGrp LOS	D		D	C	D	D	D	D	D	C		C
Approach Vol, veh/h		737			533			965			912	
Approach Delay, s/veh		48.5			46.8			50.1			21.5	
Approach LOS		D			D			D			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	30.3	31.0	17.2	13.1	5.3	56.0	22.1	8.2
Change Period (Y+Rc), s	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Max Green Setting (Gmax), s	30.0	27.0	5.0	22.0	5.0	52.0	19.0	8.0
Max Q Clear Time (g_c+I1), s	2.0	24.9	2.0	8.6	2.0	33.3	17.7	3.2
Green Ext Time (p_c), s	0.4	1.2	0.8	0.5	0.1	5.9	0.4	0.9

Intersection Summary	
HCM 2010 Ctrl Delay	40.9
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	205	135	248	87	110	50	153	550	100	243	850	848
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	216	142	261	92	116	53	161	579	105	256	895	893
Adj No. of Lanes	2	1	0	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	771	132	243	185	126	58	171	1349	244	464	850	759
Arrive On Green	0.22	0.22	0.22	0.10	0.10	0.10	0.06	0.45	0.45	0.09	0.48	0.48
Sat Flow, veh/h	3442	589	1083	1774	1212	554	1774	2995	542	1774	1771	1582
Grp Volume(v), veh/h	216	0	403	92	0	169	161	341	343	256	894	894
Grp Sat Flow(s),veh/h/ln	1721	0	1672	1774	0	1765	1774	1770	1767	1774	1770	1584
Q Serve(g_s), s	6.5	0.0	28.0	6.1	0.0	11.9	7.2	16.4	16.5	9.3	60.0	60.0
Cycle Q Clear(g_c), s	6.5	0.0	28.0	6.1	0.0	11.9	7.2	16.4	16.5	9.3	60.0	60.0
Prop In Lane	1.00		0.65	1.00		0.31	1.00		0.31	1.00		1.00
Lane Grp Cap(c), veh/h	771	0	374	185	0	184	171	797	796	464	849	760
V/C Ratio(X)	0.28	0.00	1.08	0.50	0.00	0.92	0.94	0.43	0.43	0.55	1.05	1.18
Avail Cap(c_a), veh/h	771	0	374	185	0	184	171	797	796	539	849	760
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	40.2	0.0	48.5	52.9	0.0	55.5	35.1	23.4	23.4	16.3	32.5	32.5
Incr Delay (d2), s/veh	0.2	0.0	68.4	2.1	0.0	44.4	51.6	1.7	1.7	1.0	45.6	92.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.1	0.0	20.0	3.1	0.0	8.0	8.0	8.3	8.4	4.6	40.0	45.8
LnGrp Delay(d),s/veh	40.4	0.0	116.9	55.0	0.0	99.9	86.7	25.1	25.1	17.3	78.1	125.3
LnGrp LOS	D		F	D		F	F	C	C	B	F	F
Approach Vol, veh/h		619			261			845			2044	
Approach Delay, s/veh		90.2			84.1			36.8			91.1	
Approach LOS		F			F			D			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	15.7	60.3		32.0	12.0	64.0		17.0
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	17.0	51.0		28.0	8.0	60.0		13.0
Max Q Clear Time (g_c+I1), s	11.3	18.5		30.0	9.2	62.0		13.9
Green Ext Time (p_c), s	0.4	25.1		0.0	0.0	0.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	78.3
HCM 2010 LOS	E

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	90	75	29	71	70	229	45	161	55	145	427	77
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	95	79	31	75	74	241	47	169	58	153	449	81
Adj No. of Lanes	1	1	0	1	1	1	1	2	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	394	443	174	357	379	322	387	1264	420	665	743	134
Arrive On Green	0.06	0.35	0.35	0.20	0.20	0.20	0.48	0.48	0.48	0.48	0.48	0.48
Sat Flow, veh/h	1774	1274	500	1278	1863	1583	870	2612	867	1149	1537	277
Grp Volume(v), veh/h	95	0	110	75	74	241	47	113	114	153	0	530
Grp Sat Flow(s),veh/h/ln	1774	0	1774	1278	1863	1583	870	1770	1710	1149	0	1814
Q Serve(g_s), s	0.0	0.0	2.0	2.5	1.6	6.8	2.0	1.7	1.8	4.0	0.0	10.1
Cycle Q Clear(g_c), s	0.0	0.0	2.0	4.5	1.6	6.8	12.1	1.7	1.8	5.8	0.0	10.1
Prop In Lane	1.00		0.28	1.00		1.00	1.00		0.51	1.00		0.15
Lane Grp Cap(c), veh/h	394	0	617	357	379	322	387	856	827	665	0	878
V/C Ratio(X)	0.24	0.00	0.18	0.21	0.20	0.75	0.12	0.13	0.14	0.23	0.00	0.60
Avail Cap(c_a), veh/h	437	0	896	527	627	533	387	856	827	665	0	878
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	17.2	0.0	10.8	17.8	15.7	17.8	13.4	6.8	6.8	8.4	0.0	8.9
Incr Delay (d2), s/veh	0.3	0.0	0.1	0.3	0.2	3.5	0.6	0.3	0.3	0.8	0.0	3.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.0	1.0	0.9	0.8	3.3	0.5	0.9	0.9	1.4	0.0	5.8
LnGrp Delay(d),s/veh	17.5	0.0	10.9	18.1	15.9	21.3	14.0	7.1	7.1	9.2	0.0	12.0
LnGrp LOS	B		B	B	B	C	B	A	A	A		B
Approach Vol, veh/h		205			390			274			683	
Approach Delay, s/veh		14.0			19.6			8.3			11.4	
Approach LOS		B			B			A			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6	7	8
Phs Duration (G+Y+Rc), s		27.0		20.5		27.0	6.9	13.7
Change Period (Y+Rc), s		4.0		4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		23.0		24.0		23.0	4.0	16.0
Max Q Clear Time (g_c+I1), s		14.1		4.0		12.1	2.0	8.8
Green Ext Time (p_c), s		3.8		0.8		4.3	0.2	0.9

Intersection Summary	
HCM 2010 Ctrl Delay	13.3
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	85	31	21	30	30	270	25	122	61	156	484	69
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	89	33	22	32	32	284	26	128	64	164	509	73
Adj No. of Lanes	1	1	0	1	1	1	1	2	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	351	305	204	322	294	380	423	908	431	705	877	126
Arrive On Green	0.06	0.29	0.29	0.16	0.16	0.16	0.39	0.39	0.39	0.08	0.55	0.55
Sat Flow, veh/h	1774	1044	696	1343	1863	1583	829	2331	1106	1774	1594	229
Grp Volume(v), veh/h	89	0	55	32	32	284	26	95	97	164	0	582
Grp Sat Flow(s),veh/h/ln	1774	0	1740	1343	1863	1583	829	1770	1668	1774	0	1822
Q Serve(g_s), s	0.0	0.0	1.2	1.1	0.7	5.2	1.1	1.8	1.9	2.5	0.0	10.7
Cycle Q Clear(g_c), s	0.0	0.0	1.2	2.2	0.7	5.2	3.7	1.8	1.9	2.5	0.0	10.7
Prop In Lane	1.00		0.40	1.00		1.00	1.00		0.66	1.00		0.13
Lane Grp Cap(c), veh/h	351	0	509	322	294	380	423	689	650	705	0	1003
V/C Ratio(X)	0.25	0.00	0.11	0.10	0.11	0.75	0.06	0.14	0.15	0.23	0.00	0.58
Avail Cap(c_a), veh/h	391	0	821	533	586	628	423	689	650	803	0	1003
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	19.6	0.0	13.2	19.5	18.4	7.4	11.5	10.0	10.1	6.9	0.0	7.6
Incr Delay (d2), s/veh	0.4	0.0	0.1	0.1	0.2	3.0	0.3	0.4	0.5	0.2	0.0	2.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.0	0.6	0.4	0.4	2.7	0.3	0.9	0.9	1.3	0.0	6.0
LnGrp Delay(d),s/veh	20.0	0.0	13.2	19.7	18.5	10.3	11.7	10.4	10.5	7.0	0.0	10.0
LnGrp LOS	B		B	B	B	B	B	B	B	A		B
Approach Vol, veh/h		144			348			218			746	
Approach Delay, s/veh		17.4			11.9			10.6			9.4	
Approach LOS		B			B			B			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6	7	8
Phs Duration (G+Y+Rc), s	8.2	23.8		18.9		32.0	6.9	12.0
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s	7.0	17.0		24.0		28.0	4.0	16.0
Max Q Clear Time (g_c+I1), s	4.5	5.7		3.2		12.7	2.0	7.2
Green Ext Time (p_c), s	0.1	4.0		0.5		4.7	0.1	0.8

Intersection Summary	
HCM 2010 Ctrl Delay	11.0
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	150	120	50	59	70	307	45	652	40	223	361	69
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	158	126	53	62	74	323	47	686	42	235	380	73
Adj No. of Lanes	1	1	0	1	1	1	1	2	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	365	406	171	263	340	471	448	1136	69	458	797	153
Arrive On Green	0.07	0.33	0.33	0.18	0.18	0.18	0.34	0.34	0.34	0.11	0.52	0.52
Sat Flow, veh/h	1774	1246	524	1200	1863	1583	934	3388	207	1774	1519	292
Grp Volume(v), veh/h	158	0	179	62	74	323	47	358	370	235	0	453
Grp Sat Flow(s),veh/h/ln	1774	0	1770	1200	1863	1583	934	1770	1826	1774	0	1811
Q Serve(g_s), s	0.0	0.0	4.0	2.6	1.8	5.6	1.9	9.0	9.0	4.2	0.0	8.5
Cycle Q Clear(g_c), s	0.0	0.0	4.0	6.6	1.8	5.6	1.9	9.0	9.0	4.2	0.0	8.5
Prop In Lane	1.00		0.30	1.00		1.00	1.00		0.11	1.00		0.16
Lane Grp Cap(c), veh/h	365	0	576	263	340	471	448	593	612	458	0	950
V/C Ratio(X)	0.43	0.00	0.31	0.24	0.22	0.69	0.10	0.60	0.60	0.51	0.00	0.48
Avail Cap(c_a), veh/h	377	0	796	404	558	656	448	593	612	521	0	950
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	21.1	0.0	13.5	22.4	18.6	6.3	12.4	14.8	14.8	9.8	0.0	8.0
Incr Delay (d2), s/veh	0.8	0.0	0.3	0.5	0.3	1.8	0.5	4.5	4.4	0.9	0.0	1.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.2	0.0	2.0	0.9	1.0	2.7	0.5	5.1	5.3	2.1	0.0	4.6
LnGrp Delay(d),s/veh	21.9	0.0	13.8	22.9	18.9	8.1	12.9	19.3	19.2	10.7	0.0	9.8
LnGrp LOS	C		B	C	B	A	B	B	B	B		A
Approach Vol, veh/h		337			459			775			688	
Approach Delay, s/veh		17.6			11.8			18.9			10.1	
Approach LOS		B			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6	7	8
Phs Duration (G+Y+Rc), s	10.1	21.9		21.4		32.0	7.6	13.8
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s	8.0	16.0		24.0		28.0	4.0	16.0
Max Q Clear Time (g_c+I1), s	6.2	11.0		6.0		10.5	2.0	8.6
Green Ext Time (p_c), s	0.1	3.1		1.4		7.5	0.3	1.1

Intersection Summary	
HCM 2010 Ctrl Delay	14.6
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	150	50	33	20	20	330	18	604	67	254	427	72
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	158	53	35	21	21	347	19	636	71	267	449	76
Adj No. of Lanes	1	1	0	1	1	1	1	2	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	340	283	187	248	217	442	276	1042	116	520	882	149
Arrive On Green	0.07	0.27	0.27	0.12	0.12	0.12	0.32	0.32	0.32	0.16	0.57	0.57
Sat Flow, veh/h	1774	1048	692	1304	1863	1583	874	3211	358	1774	1553	263
Grp Volume(v), veh/h	158	0	88	21	21	347	19	350	357	267	0	525
Grp Sat Flow(s),veh/h/ln	1774	0	1741	1304	1863	1583	874	1770	1800	1774	0	1816
Q Serve(g_s), s	0.0	0.0	1.9	0.7	0.5	2.0	0.9	8.2	8.2	0.0	0.0	8.7
Cycle Q Clear(g_c), s	0.0	0.0	1.9	2.7	0.5	2.0	9.6	8.2	8.2	0.0	0.0	8.7
Prop In Lane	1.00		0.40	1.00		1.00	1.00		0.20	1.00		0.14
Lane Grp Cap(c), veh/h	340	0	469	248	217	442	276	574	584	520	0	1032
V/C Ratio(X)	0.46	0.00	0.19	0.08	0.10	0.79	0.07	0.61	0.61	0.51	0.00	0.51
Avail Cap(c_a), veh/h	357	0	847	519	605	771	276	574	584	520	0	1032
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	20.5	0.0	13.8	21.3	19.4	16.4	18.2	14.0	14.0	16.4	0.0	6.5
Incr Delay (d2), s/veh	1.0	0.0	0.2	0.1	0.2	3.1	0.5	4.8	4.7	0.9	0.0	1.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.1	0.0	0.9	0.3	0.3	4.4	0.3	4.7	4.8	3.2	0.0	4.7
LnGrp Delay(d),s/veh	21.5	0.0	14.0	21.4	19.6	19.5	18.7	18.8	18.7	17.2	0.0	8.3
LnGrp LOS	C		B	C	B	B	B	B	B	B		A
Approach Vol, veh/h		246			389			726			792	
Approach Delay, s/veh		18.9			19.6			18.8			11.3	
Approach LOS		B			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6	7	8
Phs Duration (G+Y+Rc), s	12.0	20.0		17.3		32.0	7.5	9.8
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s	8.0	16.0		24.0		28.0	4.0	16.0
Max Q Clear Time (g_c+I1), s	2.0	11.6		3.9		10.7	2.0	4.7
Green Ext Time (p_c), s	2.2	1.8		0.9		4.1	0.2	1.1

Intersection Summary	
HCM 2010 Ctrl Delay	16.2
HCM 2010 LOS	B

VISSIM Access Management Results - AM Peak Hour

TT Segment	Description	Existing		Proposed Access Mgmt		Travel Time Increase	Veh*TT
		Avg Travel Time Per Vehicle	Avg Vehicles in Peak Hour	Avg Travel Time Per Vehicle	Avg Vehicles in Peak Hour		
30	E Emma to Spokane River	98.8	1	95.74	1	-3.1	-3.1
32	Spokane River to W Lacrosse	77.5	19	77.24	18	-0.3	-4.7
37	Spokane River to E Lacrosse	68.4	4	68.12	4	-0.3	-1.0
6	W Lacrosse to Spokane River	83.7	16	83.51	16	-0.2	-3.5
17	E Linden to W Linden	0.0	0	0	0	0.0	0.0
19	E Lacrosse to Ironwood	67.2	12	67.32	12	0.1	0.9
22	E Mill to Ironwood	58.1	17	58.17	17	0.1	1.8
25	E Davidson to Ironwood	51.1	24	51.24	24	0.1	2.7
39	Spokane River to E Davidson	83.4	7	83.49	7	0.1	0.9
28	E Emma to Ironwood	43.7	15	43.91	14	0.2	2.6
40	Spokane River to E Emma	89.6	16	89.81	15	0.2	3.2
38	Spokane River to E Mill	76.2	6	76.47	6	0.3	1.6
15	W Emma to Spokane River	109.9	20	110.29	20	0.4	8.5
35	Spokane River to W Emma	102.0	21	102.48	21	0.5	10.7
9	W Mill to Spokane River	93.2	14	93.82	14	0.6	8.7
12	W Davidson to Spokane River	102.1	14	102.84	14	0.7	10.4
10	W Davidson to Ironwood	74.5	19	75.57	20	1.1	21.4
13	W Emma to Ironwood	77.8	22	81.18	22	3.4	74.4
14	W Emma to E Emma	92.9	14	96.44	14	3.5	49.2
26	E Davidson to W Davidson	77.6	2	81.33	2	3.8	7.5
11	W Davidson to E Davidson	79.2	10	85.17	10	5.9	59.4
29	E Emma to W Emma	82.9	6	89.15	6	6.3	37.6
5	W Lacrosse to E Lacrosse	76.3	18	86.45	17	10.1	172.4
8	W Mill to E Mill	77.7	8	88.63	8	10.9	87.1
33	Spokane River to W Mill	84.6	12	95.9	12	11.3	135.9
7	W Mill to Ironwood	77.2	17	88.65	17	11.5	195.4
27	E Davidson to Spokane River	93.9	2	106.16	2	12.3	24.6
24	E Mill to Spokane River	89.1	4	106.88	4	17.8	71.2
23	E Mill to W Mill	73.1	4	91.28	4	18.1	72.5
4	W Lacrosse to Ironwood	83.6	20	103.26	20	**19.7**	393.2

VISSIM Access Management Results - AM Peak Hour

34	Spokane River to W Davidson	94.1	8	114.19	8	**20.1**	160.9
3	W Linden to Spokane River	61.5	5	84.42	5	**22.9**	114.4
31	Spokane River to W Linden	50.3	5	77.24	6	**27.0**	161.7
20	E Lacrosse to W Lacrosse	72.1	15	105.6	16	**33.5**	535.7
21	E Lacrosse to Spokane River	80.6	5	114.82	5	**34.2**	171.0
16	E Linden to Ironwood	71.0	13	116.47	14	**45.5**	636.3
18	E Linden to Spokane River	32.6	0	80.48	0	**47.8**	0.0
1	W Linden to Ironwood	72.6	2	123.04	2	**50.5**	100.9
36	Spokane River to E Linden	56.3	2	111.3	2	**55.0**	110.0
2	W Linden to E Linden	44.1	1	144.42	1	**100.3**	100.3
				Total vehicles	420		
				85th percentile vehicles	357		

Average increase per vehicle	**8**
85th-percentile increase per vehicle	**19**
Number of vehicles delayed longer than 1 minute	**1**
Max increase per vehicle	**100**
Vehicles at max increase	**1**

VISSIM Access Management Results - PM Peak Hour

TT Segment	Description	Existing		Proposed Access Mgmt		Travel Time Increase	Veh*TT
		Avg Travel Time Per Vehicle	Avg Vehicles in Peak Hour	Avg Travel Time Per Vehicle	Avg Vehicles in Peak Hour		
14	W Emma to E Emma	133.24	19	100.44	19	-32.8	-623.2
13	W Emma to Ironwood	103.7	53	84.98	56	-18.7	-1048.3
29	E Emma to W Emma	103.9	19	92.93	19	-11.0	-208.4
8	W Mill to E Mill	99.71	10	89.88	10	-9.8	-98.3
11	W Davidson to E Davidson	95.13	12	88.09	12	-7.0	-84.5
7	W Mill to Ironwood	97.48	33	92.34	33	-5.1	-169.6
15	W Emma to Spokane River	114.25	38	111.28	41	-3.0	-121.8
30	E Emma to Spokane River	110.23	3	108.58	3	-1.7	-5.0
10	W Davidson to Ironwood	80.87	40	79.44	40	-1.4	-57.2
26	E Davidson to W Davidson	84.45	7	83.61	7	-0.8	-5.9
32	Spokane River to W Lacrosse	76.98	5	76.77	5	-0.2	-1.1
6	W Lacrosse to Spokane River	84.35	14	84.31	14	0.0	-0.6
38	Spokane River to E Mill	77.14	4	77.11	4	0.0	-0.1
37	Spokane River to E Lacrosse	69.77	5	69.82	5	0.0	0.2
19	E Lacrosse to Ironwood	67.35	15	67.42	15	0.1	1.1
9	W Mill to Spokane River	92.74	36	92.84	36	0.1	3.6
28	E Emma to Ironwood	44.22	48	44.33	48	0.1	5.3
39	Spokane River to E Davidson	85.01	8	85.12	8	0.1	0.9
40	Spokane River to E Emma	89.99	7	90.15	7	0.2	1.1
25	E Davidson to Ironwood	52.41	20	52.62	20	0.2	4.2
22	E Mill to Ironwood	60.13	12	60.42	12	0.3	3.5
5	W Lacrosse to E Lacrosse	88.74	15	89.18	15	0.4	6.6
35	Spokane River to W Emma	102.27	19	102.8	19	0.5	10.1
12	W Davidson to Spokane River	103	16	104.23	16	1.2	19.7
23	E Mill to W Mill	89.43	12	94.79	12	5.4	64.3
24	E Mill to Spokane River	102.77	5	109.26	5	6.5	32.5
4	W Lacrosse to Ironwood	99.92	26	107.14	26	7.2	187.7
27	E Davidson to Spokane River	94.63	2	103.36	2	8.7	17.5
33	Spokane River to W Mill	85.78	17	96.64	17	**10.9**	184.6
21	E Lacrosse to Spokane River	97.12	11	117.04	11	**19.9**	219.1

VISSIM Access Management Results - PM Peak Hour

34	Spokane River to W Davidson	95.22	7	117.13	7	**21.9**	153.4
3	W Linden to Spokane River	62.89	7	87.17	7	**24.3**	170.0
31	Spokane River to W Linden	50.33	6	76.31	6	**26.0**	155.9
20	E Lacrosse to W Lacrosse	81.47	7	108.07	7	**26.6**	186.2
16	E Linden to Ironwood	73.56	23	121.91	23	**48.4**	1112.1
1	W Linden to Ironwood	75.78	7	126.94	8	**51.2**	409.3
36	Spokane River to E Linden	62.83	9	125	9	**62.2**	559.5
18	E Linden to Spokane River	82.54	6	168.83	5	**86.3**	431.5
17	E Linden to W Linden	54.33	3	142.37	3	**88.0**	264.1
2	W Linden to E Linden	58.97	3	163.01	3	**104.0**	312.1
				Total vehicles	615		
				85th percentile vehicles	523		

Average increase per vehicle	**3**
85th-percentile increase per vehicle	**10**
Number of vehicles delayed longer than 1 minute	**20**
Max increase per vehicle	**104**
Vehicles at max increase	**3**

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	571	522	122	198	515	79	343	720	80	74	716	140
Satd. Flow (prot)	1610	3282	0	1770	3468	0	1770	3456	0	1770	3539	1583
Flt Permitted	0.950	0.990		0.950			0.121			0.111		
Satd. Flow (perm)	1610	3282	0	1770	3468	0	225	3456	0	207	3539	1583
Satd. Flow (RTOR)		11			9			8				143
Lane Group Flow (vph)	421	857	0	208	625	0	361	842	0	78	754	147
Turn Type	Split	NA		Split	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases							2			6		6
Total Split (s)	49.0	49.0		34.0	34.0		32.0	62.0		15.0	45.0	45.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Act Effct Green (s)	43.0	43.0		28.0	28.0		67.3	43.1		55.1	36.1	36.1
Actuated g/C Ratio	0.27	0.27		0.18	0.18		0.43	0.27		0.35	0.23	0.23
v/c Ratio	0.96	0.95		0.66	1.00		1.03	0.88		0.30	0.93	0.31
Control Delay	89.1	74.4		71.9	98.5		112.4	65.5		48.6	77.4	9.3
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	89.1	74.4		71.9	98.5		112.4	65.5		48.6	77.4	9.3
LOS	F	E		E	F		F	E		D	E	A
Approach Delay		79.2			91.9			79.5			64.9	
Approach LOS		E			F			E			E	
Queue Length 50th (ft)	483	484		206	~358		~334	441		47	402	3
Queue Length 95th (ft)	#730	#629		302	#488		#545	492		82	#492	63
Internal Link Dist (ft)		390			413			391			458	
Turn Bay Length (ft)	210			230			365			440		
Base Capacity (vph)	440	906		315	625		351	1237		261	878	500
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.96	0.95		0.66	1.00		1.03	0.68		0.30	0.86	0.29

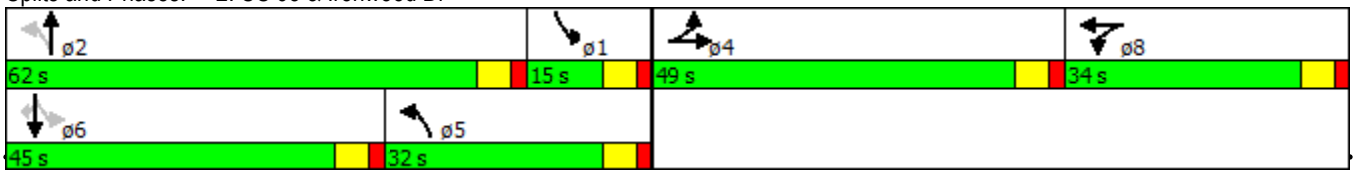
Intersection Summary

Cycle Length: 160
Actuated Cycle Length: 157.2
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.03
Intersection Signal Delay: 78.5 Intersection LOS: E
Intersection Capacity Utilization 98.8% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: US 95 & Ironwood Dr

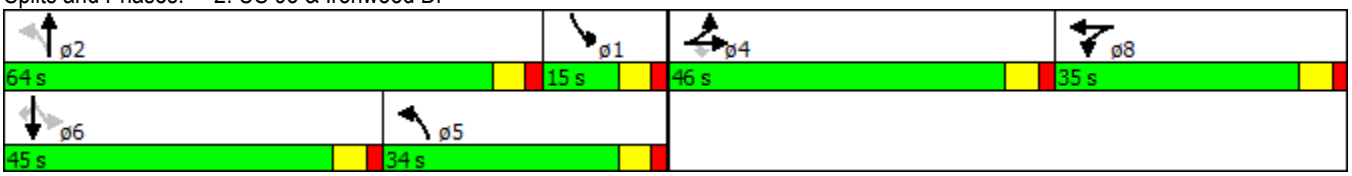


2010 PM Peak Hour with EBR Turn Lane
2: US 95 & Ironwood Dr

10/16/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	571	522	122	198	515	79	343	720	80	74	716	140
Satd. Flow (prot)	1610	3343	1583	1770	3468	0	1770	3456	0	1770	3539	1583
Flt Permitted	0.950	0.986		0.950			0.123			0.112		
Satd. Flow (perm)	1610	3343	1583	1770	3468	0	229	3456	0	209	3539	1583
Satd. Flow (RTOR)			143		9			8				143
Lane Group Flow (vph)	373	777	128	208	625	0	361	842	0	78	754	147
Turn Type	Split	NA	Perm	Split	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4				2			6		6
Total Split (s)	46.0	46.0	46.0	35.0	35.0		34.0	64.0		15.0	45.0	45.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	6.0
Act Effct Green (s)	39.0	39.0	39.0	28.9	28.9		68.2	43.0		55.9	35.8	35.8
Actuated g/C Ratio	0.25	0.25	0.25	0.19	0.19		0.44	0.28		0.36	0.23	0.23
v/c Ratio	0.92	0.93	0.25	0.63	0.96		0.97	0.87		0.28	0.92	0.31
Control Delay	85.7	74.2	6.1	68.9	87.1		97.9	63.5		46.4	75.6	9.3
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	85.7	74.2	6.1	68.9	87.1		97.9	63.5		46.4	75.6	9.3
LOS	F	E	A	E	F		F	E		D	E	A
Approach Delay		70.8			82.5			73.8			63.3	
Approach LOS		E			F			E			E	
Queue Length 50th (ft)	421	440	0	205	343		308	441		46	402	3
Queue Length 95th (ft)	#645	#569	42	300	#476		#518	490		80	#492	63
Internal Link Dist (ft)		390			413			391			458	
Turn Bay Length (ft)	210		230	230			365			440		
Base Capacity (vph)	416	865	516	332	658		381	1302		277	893	506
Starvation Cap Reductn	0	0	0	0	0		0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0		0	0	0
Reduced v/c Ratio	0.90	0.90	0.25	0.63	0.95		0.95	0.65		0.28	0.84	0.29

Intersection Summary

Cycle Length: 160
Actuated Cycle Length: 155
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 72.2 — Intersection LOS: E
Intersection Capacity Utilization 96.2% — ICU Level of Service F
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: US 95 & Ironwood Dr